Conference Program

STRC

25th Swiss Transport Research Conference
Monte Verità / Ascona, May 14 – 16, 2025

We are delighted to welcome you to the 25th edition of the Swiss Transport Research Conference (STRC).

This milestone event continues to serve as a key forum for professionals and researchers in the fields of transportation and mobility.

STRC brings together academics, consultants, and representatives from both the public and private sectors to exchange insights, share research outcomes, and engage in meaningful dialogue on pressing transport issues.

The conference fosters collaboration and innovation through a diverse program of presentations and discussions.

This year, 65 contributions will address a wide array of topics such as Demand Modeling, Public Transportation and Shared Transport Operations, Transport Data Science and Machine Learning, Sustainable Urban Mobility Planning, Traffic Flow and Control, Logistics, and Autonomous and Intelligent Transport Systems (ITS)—among many others.

The following keynote speakers have confirmed their attendance:

- **Dr. Bilge Atasoy**, Delft University of Technology, Netherlands
- **Dr. Alexandre Torday**, Aimsun
- **Prof. Andreas Schäfer**, University College London, UK

On behalf of the STRC organizing committee, welcome!

Michel Bierlaire, Transport and Mobility Laboratory, EPFL

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Questions

For questions regarding the conference, please send us an e-mail: **strc2025@epfl.ch**
If you have any questions during the conference, please call Evangelos Paschalidis:
+41 78 248 46 69

Conference venue

Fondazione Monte Verità
Strada Collina 84
CH-6612 Ascona

46.15899987655616, 8.762859915341023

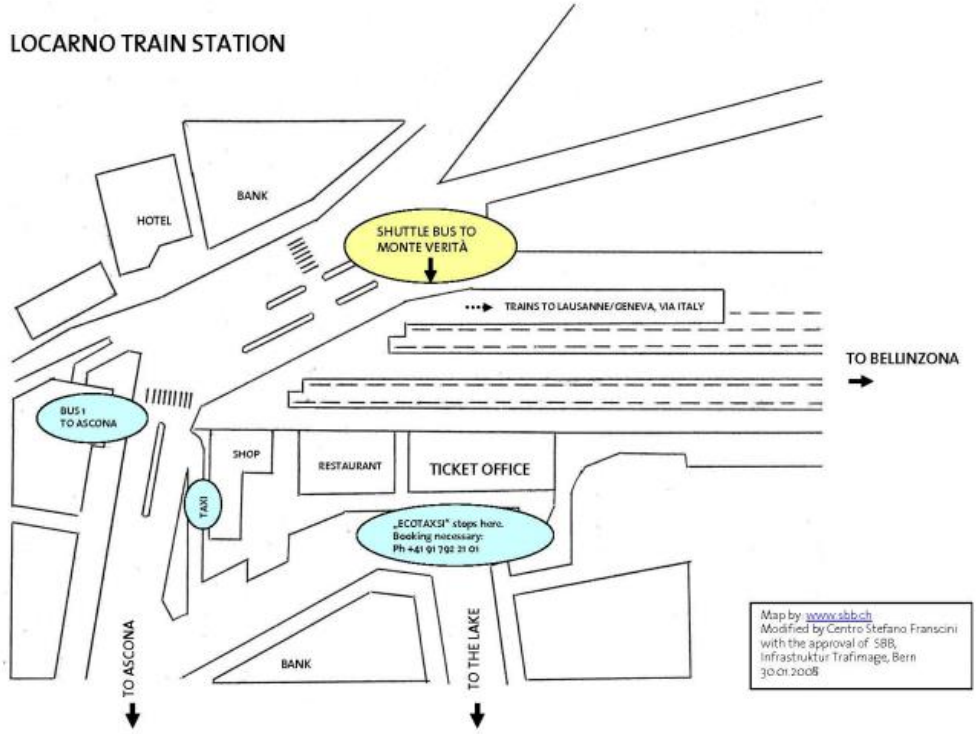
The conference venue is near the cities of Ascona and Locarno.

The auditorium is located on the ground floor. The dining room and the remaining rooms are located on the first floor, directly above the auditorium.

Arrival / Departure with shuttlebus

We recommend travelling by train to Locarno as there are only a limited number of parking spots.

On **Wednesday 14th May** there will be a shuttle service from Locarno train station to Monte Verità. The first bus departs at **11:00h** from Locarno station. We recommend attendants plan their arrival at Locarno station before **13:00h**.



Shuttle Service Schedule							
Wednesday 14th May				Friday 16th May			
From	To	Departure Time	Seats	From	To	Departure Time	Seats
Locarno Station	Monte Verità	11:00	30	Monte Verità	Locarno Station	tba	-
		11:30	8			tba	-
		12:00	30				
		12:40	50				
		13:00	14				

Arrival at the STRC-Conference

Your name badge can be found at the reception desk of the Monte Verita conference site.

Details on hotels

Check in is from **15:00h**, check out until **10:00h.** For those staying at La Perla (outside of Monte Verità conference venue), please check in ***after 15:00h and before 21:30h.***

Breakfast and lunch

Breakfast will be served from **07:30h** until **10:00h**, lunch starts at **12:00h** (Monte Verità conference site).

Dinner (Wednesday 14th) and Gala Dinner (Thursday 15th)

Dinner – Wednesday May 14th

Location: Grotto Baldoria (Via Sant'Omobono 9, 6612 Ascona)

Time: 19:15h

Distance on foot from Fondazione Monte Verità: 15–20min

Gala Dinner – Thursday May 15th

Location: Osteria Ticino da Ketty & Tommy (Via Muraccio 20, 6612 Ascona)

Time: 19:15h

Distance on foot from Fondazione Monte Verità: 20–25min

Both dinner locations are within walking distance from the Fondazione Monte Verità hotel. However, there will also be a shuttle service departing from Monte Verità at **19:00h** and back at **22:00h**.

Conference program

The program of the conference can also be accessed through the conference webpage: https://www.strc.ch/2025.php.

Details regarding the venue can be found: http://www.monteverita.org.

Information concerning travel times by train can be checked at: http://www.sbb.ch/

Details for conference photo

On **Thursday, May 15th at 18:30h**, we take a group photo directly on the steps in front of the building. Please be there on time so that you're sure to be in the photo.

Meeting of conference committee

The conference meeting for principal investigators (PIs) of the labs will take place on **Thursday, May 15th at 17:15h - 18:15h** in the *Eranos room* (all PIs of the organizing institutes of STRC Conference and conference staff 2025).

Factsheet for session-chairs

- The last presenter of each session is also chairing the session.
- Please arrive in the room **5 minutes before** the session and check that the projector is working.
- Please make **your computer available** for the presentations, which are passed over by the presenters either by memory stick or via email, or help the presenters to connect their computer to the projector.
- The presentation length will be 25 minutes. This has to be checked by you as a Session-Chair. The discussion round must not last longer than 5 minutes.
- Please prepare sheets of paper with times that you can hold up to tell the presenter the remaining time. We recommend 5 minutes and 2 minutes.
- When the time is up, please politely interrupt.
- For the Auditorium: Please be ready to pass the microphone around for the discussion.
- After the discussion, please immediately help the next presenter to set up their presentation. Please then start immediately with the introduction for the next presentation.
- When all the presentations in your session are finished, please put the room back the way you found it.

Factsheet for presenter

Presentation:
Please find below the instructions to present at the STRC-Conference:

- Presentation length will be 20 minutes
- Followed by 5 minutes of questions
- Please use your institution-template for your slides.

You can bring your presentation on a memory stick or use your own computer for the presentation. Or you can send your presentation to the chair via email.

Consider providing the following information in your slides:

- Title, name, affiliation
- What is the research question?
- Precise problem statement
- Overview of previous works
- Your proposed solution
- IF applicable: future steps within your project

Review:
Each session presenter **should review the paper following their own presentation** if the paper is available (information is provided in the conference program). The last person of the session reviews the paper of the first presentation of the session.

Please find the papers of your sessions in your *session-folder* that you have received via email before the conference.

Based on your review, you are invited to pose the first questions in the Q&A session of the corresponding paper to facilitate a smooth discussion.

If you have not uploaded your paper or want to provide a more recent version, please upload it individually into the *session-folder* or contact your reviewer.

Please note: The papers are not publicly available until the final submission after the conference. Therefore, please ensure confidentiality regarding the draft versions of the papers.

Final Paper:
The organizing committee will publish on the STRC-Homepage the latest version of your submitted paper. If you have a more recent version that you would like to upload, please upload: STRC 2025| Submission form or contact the organizing committee.

If you **do not** wish your paper to be uploaded on the STRC-Homepage please contact the organizing committee.

Participants of STRC 2025 conference

Name	Surname	Lab / Institution
Mohamed	Abdelfattah	EPFL-VITA
Alex	Alahi	EPFL-VITA
Georg	Anagnostopoulos	EPFL-LUTS
Zahra	Ansarilari	ETH-IVT-TS
Bilge	Atasoy	TU Delft
Kay	Axhausen	ETH-IVT-VPL
Lukas	Ballo	ETH-IKG
Chevallier	Benjamin	HEIG-VD, HES-SO
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Ran	Chen	EPFL-LUTS
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Thomas	Hettinger	SBB
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Jan	Lordieck	ETH-IVT-TS
Po-Chien	Luan	EPFL-VITA
Xinyu	Ma	EPFL-HOMES

Name	Surname	Lab / Institution
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de Lapparent	Matthieu	HEIG-VD, HES-SO
Jonas	Meli	ETH-IVT-TMP
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Kaouther	Messaoud	EPFL-VITA
Lucas	Meyer de Freitas	ETH-IVT-VPL
Bierlaire	Michel	EPFL-TRANSP-OR
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Anne-Valérie	Preto	EPFL-TRANSP-OR
Clément	Rames	EPFL-LASUR
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Jakob	Roth	UNIBAS-WWZ
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Dorothea	Schaffner	FHNW
Katja	Schimohr	ETH-IVT-TMP
Basil	Schmid	ARE
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Prunelle	Vogler	EPFL-TRANSP-OR
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Nina	Wiedemann	ETH-IKG
Weijiang	Xiong	EPFL-LUTS
Zhenyu	Yang	EPFL-LUTS
David	Zani	ETH-IBI-IM
Mohammadali	Zayandehroodi	ETH-IVT-SVT
Kenan	Zhang	EPFL-HOMES
Tong	Zhang	EPFL-IVRL
Pengbo	Zhu	EPFL-LUTS

Keynote speakers

Dr. Bilge Atasoy

"Adaptive transportation systems with holistic representation of supply and demand"

Bilge Atasoy is an associate professor in Delft University of Technology and working towards adaptive transport and logistics systems. Her research lies at the intersection of operations research, behavioral modeling and learning algorithms.

She is the recipient of ERC Starting Grant and runs other national and international projects. Prior to joining TU Delft, Bilge was a research scientist at the Intelligent Transportation Systems Lab at MIT where she managed projects on real-time optimization as well as choice-based optimization for various transport systems. Bilge received her PhD from EPFL as part of the Transport and Mobility Lab and prior to that she studied at Bogazici University, Türkiye.

Dr. Alexandre Torday

"From theory to practice: How research can (and should) support practical business needs"

Alex Torday is a civil engineer graduated from the Swiss Federal Institute of Technology where he also completed his PhD. As part of his past research activities, he also developed strong links with Tokyo University where he spent 6 months as invited researcher. From 2005 to 2022, he led the Aimsun Professional Services activities worldwide. He also managed the Asia-Pacific branch of Aimsun, based in Sydney, from 2012 to 2020. Since 2022, Alex is Aimsun's CEO, and moved back to the company headquarters in Barcelona, Spain.

Prof. Andreas W. Schäfer

"Decarbonising aviation"

Andreas W. Schäfer is a Professor of Energy and Transport at the School of Environment, Energy and Resources, University College London, where he directs the Air Transportation Systems Laboratory. His research covers the demand for and supply characteristics of energy and transportation systems along with their integration.

Schedule overview

Wednesday, May 14th

12:00 –14:00	Registration and sandwich Lunch		
14:00-14:10	Welcome (Auditorium)		
14:10 - 15:10	Keynote 1: Dr. Bilge Atasoy (Auditorium)		
15:10 - 15:40	Coffee Break - Check-in		
	Session 1A:	**Session 1B:**	**Session 1C:**
	Auditorium	**Sala Balint**	**Sala Eranos**
15:40 - 16:05	Y. Tak	B. Chevallier	J. Linke
16:05 - 16:30	Y. Hong	J. Roth	G. Anagnostopou-los
16:30 - 16:55	Y. Haghighi	C. Rames	L. Ballo
16:55 - 17:05	Short Break		
	Session 2A:	**Session 2B:**	**Session 2C:**
	Auditorium	**Sala Balint**	**Sala Eranos**
17:05 - 17:30	Z. Yang	B. Tomarchio	P.C. Luan
17:30 - 17:55	T. Zhang	Y. Gao	L. Sun
17:55 - 18:20	B. Hinter-mann	V. Klasovitá	M. Fernando
19:15	Dinner		

Thursday, May 15th

07:30 - 09:00	Breakfast		
09:00 - 10:00	Keynote 2: Dr. Alexandre Torday (Auditorium)		
10:00 - 10:30	Coffee Break		
	Session 3A:	**Session 3B:**	**Session 3C:**
	Auditorium	**Sala Balint**	**Sala Eranos**
10:30 - 10:55	M. Maljkovic	R. Hos-seininejad	K. Schimohr
10:55 - 11:20	L. Schwab	A. V. Preto	E. Brugger
11:20 - 11:45	I. Kaddoura	S. Papini	A. Reiffer
11:00 - 11:30	Coffee-Break		
12:00 - 13:30	Lunch		
	Session 4A:	**Session 4B:**	**Session 4C:**
	Auditorium	**Sala Balint**	**Sala Eranos**
13:30 - 11:55	M. Kukic	N. Wiedemann	D. Zani
13:55 - 14:20	B. Gramsch-Calvo	N. Ortelli	M. Za-yandehroodi
14:20 - 14:45	M. Wang	P. Ilinov	L. Feng
14:45 - 15:10	K. Riehl	P. Zhu	L. Meyer de Freitas
15:10 - 15:40	Coffee-Break		
	Session 5A:	**Session 5B:**	**Session 5C:**
	Auditorium	**Sala Balint**	**Sala Eranos**
15:40 - 16:05	J. Shan	N. Rezvany	J. Lordieck
16:05 - 16:30	M. Pham-Truffert	R. Chen	P. Vogler
16:30 - 16:55	S. El-Baklish	K. Messaoud	T. Haering
17:15 - 18:15	Committee meeting (Eranos)		
18:30	Photo (at stairway)		
19:15	Gala Dinner		

Friday, May 16th

07:30 - 09:00	Breakfast		
	Session 6A:	**Session 6B:**	**Session 6C:**
	Auditorium	**Sala Balint**	**Sala Eranos**
09:00 - 09:25	J.M. Hen-choz	M. He	M. Hassan
09:25 - 09:50	D. Guggis-berg	Y.C. Ni	M. Seger
09:50 - 10:15	B. Schmid	W. Xiong	J. Meli
10:15 - 10:35	Coffee-Break		
	Session 7A:	**Session 7B:**	**Session 7C:**
	Auditorium	**Sala Balint**	**Sala Eranos**
10:35 - 11:00	X. Liu	Z. An-sarilari	F. Fouchs
11:00 - 11:25	Y. Borhani	X. Ma	M. Abdelfattah
11:25 - 11:50	A. Elvarsson	C. Chen	
11:50 - 12:00	Short Break		
12:00 - 13:00	Keynote 3: Prof.Andreas Schäfer (Auditorium)		
13:00	Closing of the Conference (Auditorium)		

Sessions 1: Wednesday, May 14th 2025

Chair	Yasaman Haghighi (EPFL-VITA)	**Session 1A**		
Room	Auditorium			
No.	**Start**	**End**	**Speaker**	**Title**
1.1	15:40	16:05	Yura Tak (EPFL-LUTS)	Moving Drone-Based Trajectory Extraction Through Referential Drone Map
1.2	16:05	16:30	Ye Hong (ETH-IKG)	Causal Inference for Interpretable and Robust Deep Learning in Mobility Analysis
1.3	16:30	16:55	Yasaman Haghighi (EPFL-VITA)	Scene-Aware Human Motion Generation
Chair	Clément Rames (EPFL-LASUR)	**Session 1B**		
Room	Sala Balint			
No.	**Start**	**End**	**Speaker**	**Title**
1.4	15:40	16:05	Benjamin Chevallier (HEIG-VD, HES-SO)	A decision-support system for brownfield rehabilitation: Optimizing material usage and transport for sustainable urban redevelopment
1.5	16:05	16:30	Jakob Roth (UNIBAS-WWZ)	Mode Choice for Leisure Travel in Europe: Simulating Future Transport Policies
1.6	16:30	16:55	Clément Rames (EPFL-LASUR)	The interaction between motility, accessibility and modal choice
Chair	Lukas Ballo (ETH-IKG)	**Session 1C**		
Room	Sala Eranos			
No.	**Start**	**End**	**Speaker**	**Title**
1.7	15:40	16:05	Jannis Linke (IMO-HSG)	Employers' Potential to Drive Greener Transport: Examining Swiss Employees' Willingness to Subscribe to Employer-Subsidized Sustainable Mobility Solutions
1.8	16:05	16:30	Georg Anagnostopoulos (EPFL-LUTS)	Propagation of perturbations in far-from-equilibrium multispecies traffic systems: a simulation approach
1.9	16:30	16:55	Lukas Ballo (ETH-IKG)	Urban utopias for realists: An automated generation and testing of urban mobility visions

Sessions 1 - abstracts

Session 1A

Yura Tak

Moving Drone-Based Trajectory Extraction Through Referential Drone Map

Yura Tak (EPFL-LUTS), Robert Fonod (EPFL-LUTS), Nikolas Geroliminis (EPFL-LUTS)

A critical challenge in large-scale traffic monitoring from aerial imagery is maintaining a consistent spatial referential across multiple video frames, particularly when a drone moves and captures different viewpoints of a scene. In this research, we present a novel framework that leverages automated image stitching techniques to construct a unified, high-resolution "drone map" from carefully selected frames. Our approach begins by evaluating candidate frames for their quality and suitability based on criteria such as frame sharpness and the number of reliable keypoint matches. The selected frames are then seamlessly stitched together to form a common, stable referential coordinate system that spans the entirety of the observed region. With the drone map established, individual frames are aligned to this global reference, allowing accurate transposition of detected vehicle positions and identities from each frame onto the unified map. This process enables consistent vehicle tracking across the entire duration of the video, despite drone motion and varying viewpoints. As a result, we can extract precise vehicle trajectories and conduct robust traffic flow analyses over a large spatial area without the complexities introduced by frame-to-frame coordinate shifts. The proposed methodology advances the use of drones as mobile traffic monitoring platforms, offering improved accuracy, scalability, and continuity in vehicular movement analysis.

Ye Hong

Causal Inference for Interpretable and Robust Deep Learning in Mobility Analysis

Ye Hong (ETH-IKG), Martin Raubal (ETH-IKG)

Deep learning (DL) networks are increasingly utilized in mobility analysis and predictive modeling, yet their intricate internal workings hinder interpretability and complicate robustness assessments, limiting real-world deployment. Recent studies identified causal inference as a promising method for evaluating DL robustness, as it enables the extraction of interpretable and actionable insights. This study introduces a causal intervention framework to assess how mobility-related factors influence DL networks for next-location prediction. We employ mechanistic mobility models to simulate location visit sequences and control behavioral dynamics through targeted interventions in data generation. The modified sequences are analyzed using standardized mobility metrics and processed through pre-trained DL networks to quantify performance variations. Performance deviations highlight three key behavioral factors: (1) sequential patterns in location transitions, (2) individual tendencies for spatial exploration, and (3) heterogeneity in location preferences at both the population and individual levels. We publicly released a modular, opensource Python framework that includes formal data specifications, mobility models for synthetic dataset generation, benchmark DL architectures, and evaluation protocols. These insights contribute to the practical implementation of mobility prediction systems, while the framework establishes a foundation for integrating causal inference to improve DL interpretability and robustness in mobility applications.

Yasaman Haghighi

Scene-Aware Human Motion Generation

Yasaman Haghighi (EPFL-VITA), Alexandre Alahi (EPFL-VITA)

We present a new approach for enhancing spatial controllability in diffusion-based human motion generation. Although diffusion-based models generate realistic human motions under unconditional and text-conditioned settings, they often struggle with spatial conditions. Effective spatial control in motion generation involves ensuring specific joints passthrough designated key points, enabling control over the position of any joint throughout the generated sequence. Additionally, spatial control should allow for realistic scene interaction, ensuring generated motions avoid penetrating obstacles within the environment. We propose tackling the challenges of spatially conditioned motion generation by employing inference guidance during the denoising steps of diffusion models. The guidance updates the motion based on a loss function that measures adherence to spatial constraints. However, strong guidance can compromise motion realism, while insufficient guidance may not satisfy spatial conditions. Our method, addresses these challenges with an uncertainty-aware guidance approach that dynamically adjusts guidance intensity based on noise levels at each denoising step. Our approach is plug-and-play, can integrate with any conditional or unconditional motion generation model to enhance spatial controllability, offering broad applicability and versatility. By combining uncertainty-aware guidance with refined loss functions, our method achieves state-of-the-art performance in spatial controllability and scene navigation, achieving an effective balance between realism and spatial precision.

Session 1B

Benjamin Chevallier

A decision-support system for brownfield rehabilitation: Optimizing material usage and transport for sustainable urban redevelopment

Selin Ataç (HEIG-VD, HES-SO), Benjamin Chevallier (HEIG-VD, HES-SO), Matthieu de Lapparent (HEIG-VD, HES-SO)

The valorization of brownfields presents a significant challenge in urban redevelopment, as decisions in this domain involve a trade-off between environmental sustainability and financial feasibility. Our study, focusing on three sites in Switzerland, introduces a comprehensive decision-support system (DSS) that integrates operations research methodologies to optimize the rehabilitation process of such sites. Within this DSS, we identify key cost components related to material transport and rehabilitation expenses, including routing, vehicle usage, tools, materials, storage, transformation/repackaging, and recycling costs. Our DSS finds the most efficient strategy while considering (i) spatial constraints, i.e., the locations of brownfield sites, storage sites, recycling centers, transformation/repackaging facilities, and construction sites; (ii) technical constraints, i.e., facility and vehicle capacities and material-related restrictions; and (iii) financial constraints, i.e., budget limitations. By developing a mixed-integer linear programming model, we aim to provide the optimal assignment of materials between sites and the vehicle routing of material transport. The results of this research are planned to be integrated into a brownfield rehabilitation framework that benefits from circular economy practices in construction, proposing incentives to promote sustainability.

Jakob Roth

Mode Choice for Leisure Travel in Europe: Simulating Future Transport Policies

Jakob Roth (UNIBAS-WWZ), Laura Schwab (UNIBAS-WWZ)

The European travel sector is experiencing a transformation driven by increased climate awareness and policy measures aimed at reducing emissions. This study examines how Swiss travelers respond to these developments, using a stated preference choice experiment including the modes train, night train, car, and airplane. We calculate price elasticities and find a significant willingness-to-pay (WTP) of CHF 9.38 for sustainable aviation fuel (SAF), while the (lower) WTP for carbon offsetting remains insignificant. Based on the estimated coefficients, we evaluate the potential impacts of four planned policy scenarios: a flight tax (30 CHF), a subsidy for night trains (20 CHF), a SAF blending quota (50%), and a realistic market outlook for 2030 including a mixture of policies. These planned policies are then compared to the first-best Pigovian tax on external costs. After assessing demand shifts, changes in consumer surplus, and welfare effects including external costs, we find that, except for the 2030 scenario, all planned policies are welfare-decreasing. Key contributions include the integration of night trains into the analysis of holiday travel choices, as well as a detailed examination of the role of SAF and carbon offsetting in air travel decisions.

Clément Rames

The interaction between motility, accessibility and modal choice

Clément Rames (EPFL-LaSUR), Eloi Bernier (EPFL-LaSUR), Jules Grandvillemin (EPFL-LaSUR), Florian Masse (EPFL-LaSUR), Guillaume Drevon (EPFL-LaSUR), Philippe Gerber (LISER, Luxemburg), Vincent Kaufmann (EPFL-LaSUR)

While built environment characteristics, in particular transport infrastructure, play a pivotal role in modal practices (Ewing & Cervero, 2010, Van Acker et al., 2007), individual attributes, for instance travel dispositions and aptitudes, are equally decisive in the choice of modes of transport (Kaufmann, 2011). In this paper, we leverage a large panel survey dataset (n=10,202) covering the Lemanic Arc (straddling Switzerland and France) conducted in 2022. We pose three hypotheses. The first is that motility and accessibility both influence modal practices in specific ways. The second is that motility, defined as the potential to be mobile, varies as a function of the accessibility of one's environment. Finally, we hypothesize that motility has a compensatory dimension for deficiencies in accessibility. In order to test these, we adopt a Structural Equation Modeling (SEM) approach (Hoyle, 2014). We construct three latent variables – Motility, Accessibility and Mode Choice – which are first tested individually with Confirmatory Factor Analysis. The complex relationship between these three aspects is then evaluated with a SEM model. The model converges, with appropriate indicators of fit, and validates the first two hypotheses. Results also show that individuals living in more accessible environments tend to possess higher motility, countering our third hypothesis.

Session 1C

Jannis Linke

Employers' Potential to Drive Greener Transport: Examining Swiss Employees' Willingness to Subscribe to Employer-Subsidized Sustainable Mobility Solutions

Jannis Linke (IMO-HSG), Luisa Stöhr (IMO-HSG)

Work-related travel accounts for 28% of daily distances travelled in Switzerland, contributing, for example, to rising emissions and urban space constraints. As an emerging trend, employers, including Roche and Google, are offering mobility solutions to attract talent and meet emission reporting requirements. While these cases highlight the potential for fostering the uptake of sustainable mobility solutions, research on general employee demand for employer-subsidized mobility offers remains limited. This study examines employees' willingness to subscribe to employer-subsidized sustainable mobility products, including electric car leasing, company bike leasing, GA travelcards, local fare network travelcards, car-sharing, micromobility sharing, and mobility budgets. Data from n = 1,112 employees in Switzerland were collected via an online survey using quota sampling in October 2024. Respondents evaluated detailed product scenarios, considering functionality and personal costs. The analysis will use multiple linear regression to identify how factors such as sociodemographics, current commuting modes and general interest in products influence employees' willingness to subscribe to employer subsidized mobility products. This study contributes to understanding the potential of employer-subsidized mobility options from an employee demand perspective, serving as one building block for promoting sustainable mobility.

Georg Anagnostopoulos

Propagation of perturbations in far-from-equilibrium multispecies traffic systems: a simulation approach

Georg Anagnostopoulos (EPFL-LUTS), Nikolas Geroliminis (EPFL-LUTS)

A fundamental question in transportation, and more specifically in traffic flow theory, concerns the issue of delays. To this day, this has been the center of a heated philosophical debate, mainly between physicists and traffic engineers. The latter argue that delays are caused by discrete disruptions in the system, such as accidents, whereas the former claim that stochastic processes in continuous time can generate unreasonably large jams, similar to the butterfly effect. In this paper, we investigate a combination of both arguments and their combined effect on a multispecies system using nonequilibrium simulations.

Lukas Ballo

Urban utopias for realists: An automated generation and testing of urban mobility visions

Lukas Ballo (ETH-IKG), Raphael Eder (UC San Diego), Kay W. Axhausen (ETH-IVT-VPL), Martin Raubal (ETH-IKG)

Rapid urbanization, changing economies, and climate change are placing great demands on urban planners. Housing millions of additional people, transforming from manufacturing to knowledge work, and cutting emissions to net zero are only possible with large changes to urban policies and built environments. Such transformation cannot be achieved by mere optimization of existing structures but rather demands bold visions that have the power to focus collective efforts over the coming decades. In the E-Bike City project, the team has developed one such vision for Zurich, based on the idea of allocating large proportions of road space to lightweight modes. Building on top of tools and methodologies developed in that project, we now introduce a generalization of this approach, helping planners and policymakers in any city in the world test a wide range of possible bold urban mobility futures. Unlike present approaches with many manual design and impact assessment steps, our approach offers an automated design process based on user inputs–starting from natural language inputs and resulting in a detailed network plan, as well as an impact report. Our approach is based on three steps: (1) Conversion of unstructured user inputs into structured design constraints, (2) Automated generation of consistent transport networks within existing and/or added infrastructure, and (3) Quick impact assessment with accessibility, travel times, or estimated emissions. Our approach can help communities all over the world engage in meaningful discussions about the future of their urban development and through experimentation, reach a consensus on the kind of cities they want to make a reality.

This research is part of the E-Bike City project, partly funded by the Department of Civil, Geomatic and Environmental Engineering ETH Zürich and the Swiss Federal Office of Energy.

Sessions 2: Wednesday, May 14th 2025

Chair	Beat Hintermann (UNIBAS-WWZ)	**Session 2A**		
Room	Auditorium			
No.	**Start**	**End**	**Speaker**	**Title**
2.1	17:05	17:30	Zhenyu Yang (EPFL-LUTS)	On the Bottleneck Priority Allocation without Transactions
2.2	17:30	17:55	Tong Zhang (EPFL-HOMES)	Multi-modal Transportation Network Design Integrating UAM Mode: An Activity Capacity-based Approach
2.3	17:55	18:20	Beat Hintermann (UNIBAS-WWZ)	Transport Pricing to Promote E-biking and Reduce Externalities: In-sights from a GPS-Tracked Experiment
Chair	Viera Klasovitá (ETH-IVT-TS)	**Session 2B**		
Room	Sala Balint			
No.	**Start**	**End**	**Speaker**	**Title**
2.4	17:05	17:30	Barbara Tomarchio (EPFL-TRANSP-OR)	Routing optimization for organic waste collection
2.5	17:30	17:55	Yang Gao (EPFL – VITA)	OmniTraj: Pre-Training on Heterogeneous Data for Adaptive and Zero-Shot Human Trajectory Prediction
2.6	17:55	18:20	Viera Klasovitá (ETH-IVT-TS)	Including Uncertainties in Line Planning
Chair	Malithi Fernando (ETH-IVT-TMP)	**Session 2C**		
Room	Sala Eranos			
No.	**Start**	**End**	**Speaker**	**Title**
2.7	17:05	17:30	Po-Chien Luan (EPFL-VITA)	Toward Monocular Human Trajectory Prediction
2.8	17:30	17:55	Linghang Sun (ETH-IVT-SVT)	Unveiling the effect of real-world supply-side disruption on urban traffic networks
2.9	17:55	18:20	Malithi Fernando (ETH-IVT-TMP)	The Evolution of Shopping Behaviour: A Comparative Study of Four European Countries

Sessions 2 - abstracts

Session 2A

Zhenyu Yang

On the Decentralization of Optimal Ride-sharing Organization with Autonomous Vehicles and Priority Schemes

Dan Zhu (NU Singapore), Zhenyu Yang (EPFL-LUTS), Nikolas Geroliminis (EPFL-LUTS)

This study addresses the optimization of ride-sharing in a capacitated network under pricing and priority schemes. With the advent of Automated Mobility on Demand (AMoD), the demand for ride-hailing is expected to rise, potentially exacerbating traffic congestion due to modal shifts. One way to mitigate congestion is to encourage travelers to share rides. High Occupancy Vehicle (HOV) lanes have traditionally been used to incentivize ride-sharing to avoid congestion. Here, we consider a ride-sharing platform that allows users to form groups to minimize their total trip cost. We show that, with appropriately designed link-based congestion pricing and priority schemes, a system-optimal ride-sharing outcome can be achieved in a decentralized manner. Our numerical results indicate that when the priority scheme is properly designed, the toll needed to decentralize the system optimum can be reduced. We also demonstrate that the congestion pricing scheme can be implemented in an area-based manner without significantly compromising efficiency.

Tong Zhang

Multi-modal Transportation Network Design Integrating UAM Mode: An Activity Capacity-based Approach

Tong Zhang (SEU, China, EPFL-HOMES), Dawei Li (SEU, China), Chongqi He (SEU, China), Kenan Zhang (EPFL-HOMES)

Given the limited number of electric Vertical Take-off and Landing (eVTOL) airports and their restricted coverage, air-ground coordination is crucial for achieving seamless multi-modal travel through strategies like transportation capacity matching and timetable synchronization. Developing a multi-modal network design method that integrates Urban Air Mobility (UAM) is increasingly urgent. While traffic network capacity is a commonly used optimization objective in network design, existing methods often fall short in areas such as analyzing activity-oriented travel demand, incorporating land-use information, and supporting design requirements from the activity perspective, such as maximizing the capacity to accommodate activity flow, to prevent the traffic network from impeding urban vitality enhancement. To address these gaps, this paper introduces the Activity Capacity-based Multi-modal Network Design Problem (AC-MNDP) model, which can deliver the network design scheme that maximizes the capacity to accommodate activity flow and the corresponding distribution of demands and flows. The model is structured into a three-layer programming approach: the upper-level model considers network design under investment constraints, the middle-level model focuses on maximizing activity capacity within land-use and activity structure constraints, and the lower-level model is a Multi-modal Activity-Travel Assignment model (MATA). A Sensitivity Analysis-Based algorithm (SAB) is developed to solve the model. Numerical case studies validate the model's ability to generate multi-modal network design schemes under varying investment constraints, comparing

activity capacity-based with traffic network capacity-based design methods, and offering insights from a sensitivity analysis of UAM travel costs and capacity thresholds.

Beat Hintermann

Transport Pricing to Promote E-biking and Reduce Externalities: Insights from a GPS-Tracked Experiment

Jakob Roth (UNIBAS-WWZ), Laura Schwab (UNIBAS-WWZ), Beat Hintermann (UNIBAS-WWZ), Thomas Götschi (UOregon), Adrian Meister (ETH-IVT), Lucas Meyer de Freitas (ETH-IVT-VPL), Kay W. Axhausen (ETH-IVT-VPL)

This study presents results from a pre-registered randomized controlled trial involving 1,085 participants in Switzerland that have access to an E-bike, a car and public transport, and whose transport choices are monitored via a GPS-based app. The treatment consists in a monetary incentive that captures the main external costs and benefits associated with transport in the form of a Pigovian tax. This tax captures external damages from local and global pollution, health costs and benefits related to accidents and physical exercise, and congestion costs. We implemented the tax by first providing participants with an individualized budget, from which the transport tax is then deducted on a weekly basis. In the experiment, the tax reduces transport-related external costs by 6.5%, predominantly by encouraging a shift away from driving towards E-biking and walking. Participants reduce their car travel distance by 8.2% on average, while increasing their cycling and walking distance by 12.6% and 6.1%, respectively. The effect is primarily driven by individuals who own a ''fast'' E-bike with support up to 45 km/h, rather than users of regular E-bikes. Besides a reduction in overall driving, the pricing also induces a shift of travel towards less congested time windows.

Session 2B

Barbara Tomarchio

Routing optimization for organic waste collection

Barbara Tomarchio (HES-SO, EPFL-TRANSP-OR), Sacha Varone (HES-SO), Léa Ricard (EPFL-TRANSP-OR), Michel Bierlaire (EPFL-TRANSP-OR)

We introduce and study a new variant of the Vehicle Routing Problem (VRP) that integrates waste quality considerations into the routing solution. This new problem arises from a real-world application: the collection of organic waste containers. The quality of each container is determined by its quantity of organic and inorganic waste, the latter resulting from inadequate sorting practices. If the quality of the waste is sufficient, it can be taken to a recycling facility; otherwise, it must be taken to an incinerator. We extend the traditional vehicle routing problem with intermediate facilities (VRP-IF) by proposing a new Mixed-Integer Linear Programming (MILP) formulation enhanced with valid inequalities. In order to integrate waste quality into this model, specific constraints are added, in particular to ensure that vehicles unload at the incinerator when the quality of the waste they carry is insufficient. In addition, the different costs associated with unloading at the two different facilities are integrated into the objective function. Since the problem under discussion is new, there are no instances with similar characteristics available in the literature. Therefore, we generate new instances and present optimal results obtained on small instances.

The results show that the addition of the valid inequalities significantly reduces the computational time. Indeed, the MILP formulation with these valid inequalities allows us to find the optimal solution for all instances within one hour, whereas this is not the case for all instances if these inequalities are omitted.

Yang Gao

Transmotion++: A Foundation Model for Human Motion Prediction

Yang Gao (EPFL-VITA), Po-Chien Luan (EPFL-VITA), Kaouther Messaoud (EPFL-VITA), Lan Feng (EPFL-VITA), Alexandre Alahi (EPFL-VITA)

The ability of intelligent systems to predict human behaviors is crucial, particularly in fields such as autonomous vehicle navigation and social robotics. However, the complexity of h man motion have prevented the development of a standardized dataset for human motion predi tion, thereby hindering the establishment of pre-trained models. In this paper, we address these limitations by integrating multiple datasets, encompassing both trajectory and 3D pose keypoints, to propose a pre-trained model for human motion prediction. We merge seven distinct datasets across varying modalities and standardize their data formats. To facilitate multimodal pre-training, we introduce MultiTransmotion++, an innovative transformer-based model designed for cross-modality pretraining. Additionally, we present a novel masking strategy to capture rich representations.

Viera Klasovitá

Including Uncertainties in Line Planning

Viera Klasovitá (ETH-IVT-TS), Francesco Corman (ETH-IVT-TS)

This paper examines some important aspects of uncertainties in the line planning problem within the context of public transport. By exploring different approaches to seamlessly integrate uncertainty into the line planning process, the study evaluates the impact of various uncertainties, such as passenger demand and infrastructure restrictions, on the system. This includes assessing factors like passenger satisfaction and cost-effectiveness. The value of the stochastic solution, as well as the expected value of perfect information, are analysed in order to understand how well the stochastic solution performs. Through this comprehensive analysis, we aim to enhance our understanding of the challenges posed by uncertainty in line planning and other planning steps, ultimately offering practical solutions for building more resilient and responsive public transport systems.

Session 2C

Po-Chien Luan

Toward Monocular Human Trajectory Prediction

Po-Chien Luan (EPFL-VITA), Alexandre Alahi (EPFL-VITA)

Conventional human trajectory prediction models typically rely on clean, curated data, neglecting the accumulated errors from upstream tasks—a limitation that restricts their effectiveness in real-world robotic applications. To overcome this challenge, we present UniHuman, a Transformer-based framework that jointly addresses perception and prediction using only a monocular camera. UniHuman employs a spatial-temporal attention mechanism to reconstruct SMPL representations for each detected human in the 3D plane. Specifically, the spatial attention module enhances 3D localization accuracy, while the temporal attention module ensures smooth trajectory predictions. Experimental results demonstrate that UniHuman not only achieves precise human localization and future trajectory prediction but also shows that accurate trajectory prediction can significantly improve tracking performance.

Linghang Sun

Unveiling the effect of real-world supply-side disruption on urban traffic networks

Linghang Sun (ETH-IVT-SVT), Michail A. Makridis (ETH-IVT-SVT), Anastasios Kouvelas (ETH-IVT-SVT)

Many established traffic control strategies such as perimeter control and dynamic pricing rely on traffic models like Macroscopic Fundamental Diagram (MFD), following a static well-defined function form. However, traffic networks in the real world are subject to frequent disruptions that may easily violate the assumption of a constant MFD. Based on the historical records of road construction works over the past few years in the city of Zurich, we unveil the negative effects of such disruptions on the modeling of urban traffic networks. By applying a recently proposed infrastructure potential indicator to describe the variations of MFDs under disruption, a clear decline in the infrastructure potential can be observed, followed by a gradual recovery over time. In addition, by considering several features relevant to each instance of disruptions, such as the area of construction, traffic class of the affected roads, and speed limit, we tested several algorithms, including a simple linear regression, random forest, and 1D CNN to predict the effect of a road construction work. However, due to the current limited data availability, the linear regression shows a certain degree of prediction capability while the more advanced 1D-CNN fails to do so.

Malithi Fernando

The Evolution of Shopping Behaviour: A Comparative Study of Four European Countries

Malithi Fernando (ETH-IVT-TMP), Dipanjan Nag (NTNU), Abel Kebede Reda (Gustav Eiffel University), Anna Reiffer (ETH-IVT-TMP), Laetitia Dablanc (IFSTTAR), Trude Tørset (NTNU), Giulio Mattioli (TU Dortmund), Eva Heinen (ETH-IVT-TMP)

Shopping trips are a fundamental component of daily travel routines but are less extensively studied than commute or leisure trips. The rise of online shopping—accelerated by the COVID-19 pandemic—has transformed shopping travel patterns, presenting new challenges and opportunities for urban and suburban logistics operations in spaces traditionally dominated by passenger flows. This study examines shopping and non-shopping travel behaviour patterns across France, Germany, Norway, and Switzerland using comparative travel data to identify trends and influencing factors. By analysing trip demand patterns across socioeconomic and geographic factors, we reveal how societal trends and policy measures have shaped mobility choices. Since 2005, Swiss data show that men have increased shopping trips as a share of total travel, while women's share has declined—though they still make more shopping trips in absolute terms. Higher-income groups have also increased their use of sustainable transport modes for shopping trips, diverging from historical trends where rising income correlated with higher car use. Understanding how different population groups meet their daily travel needs can inform urban and suburban planning initiatives, such as the 15-minute city concept, which aims to shorten travel distances and promote sustainable mobility.

Sessions 3: Thursday, May 15th 2025

Sessions 3				
Chair	Ihab Kaddoura (SBB)	**Session 3A**		
Room	Auditorium			
No.	**Start**	**End**	**Speaker**	**Title**
3.1	10:30	10:55	Marko Maljkovic (EPFL-LUTS)	Deep Recurrent Q-Learning for Multi-Agent Traffic Patrolling
3.2	10:55	11:20	Laura Schwab (UNIBAS-WWZ)	Sustainable Commuting at Roche: Exploring Mode Choice and Corporate Policy Impacts
3.3	11:20	11:45	Ihab Kaddoura (SBB)	Quantifying Future Mobility: Scenario-Based Analysis with Agent-Based Modeling
Chair	Sebastiano Papini (ETH-D-MTEC-CAE)	**Session 3B**		
No.	Sala Balint			
Präsentation	**Start**	**End**	**Speaker**	**Title**
3.4	10:30	10:55	Reyhaneh Hosseininejad (EPFL-VITA)	Multimodal Human Motion Forecasting, From Local to Global
3.5	10:55	11:20	Anne-Valérie Preto (EPFL-TRANSP-OR)	Differentiation of Modal Preferences in Public Transportation
3.6	11:20	11:45	Sebastiano Papini (ETH-D-MTEC-CAE)	Mapping Cycling-Specific Infrastructure Using Object Detection on Remotely Sensed Images
Chair	Anna Reiffer (ETH-IVT-TMP)	**Session 3C**		
Room	Sala Eranos			
No.	**Start**	**End**	**Speaker**	**Title**
3.7	10:30	10:55	Katja Schimohr (ETH-IVT-TMP)	Household shopping trips: exploring travel patterns and links to the built environment
3.8	10:55	11:20	Elisabeth Brugger (ETH-IVT-TS)	Understanding relations of objectives in railway timetabling
3.9	11:20	11:45	Anna Reiffer (ETH-IVT-TMP)	Understanding Barriers to Active Lifestyles: Analyses of Active Travel and Exercise in Multiweek Time Use and Travel Diary Data

Sessions 3 - abstracts

Session 3A

Marko Maljkovic

Deep Recurrent Q-Learning for Multi-Agent Traffic Patrolling

Marko Maljkovic (EPFL-LUTS), Nikolas Geroliminis (EPFL-LUTS)

Efficient traffic monitoring is crucial for managing urban transportation networks, especially under congested and dynamically changing traffic conditions. Drones offer a scalable and cost-effective alternative to fixed sensor networks; however, deploying fleets of low-cost drones for traffic monitoring poses challenges in adaptability, scalability, and real-time operation. To address these issues, we propose a learning-based framework for decentralized traffic monitoring with drone swarms, targeting the uneven and unpredictable distribution of monitoring needs across urban areas. Our approach introduces a semi-decentralized reinforcement learning model, which trains a single Q-function using the collective experience of the swarm. This model supports full scalability, flexible deployment, and, when hardware allows, the online adaptation of each drone's action-selection mechanism. We first train and evaluate the model in a synthetic traffic environment, followed by a case study using real traffic data from Shenzhen, China, to validate its performance and demonstrate its potential for real-world applications in complex urban monitoring tasks.

Laura Schwab

Sustainable Commuting at Roche: Exploring Mode Choice and Corporate Policy Impacts

Laura Schwab (UNIBAS-WWZ)

Many large corporations, including Roche, aim to encourage sustainable commuting behaviors to enhance employer attractiveness, improve corporate reputation, comply with Scope 3 emissions reporting, and reduce external costs. This study analyzes commuting patterns using advanced discrete choice models for car, public transport and bicycle modes. Using a panel dataset of 12,000 Roche employees in Switzerland, with repeated observations from September 2023 to May 2024, mixed multinomial logit models estimate preference parameters and identify heterogeneity across sociodemographic groups. The results indicate that cross-border commuters, shift workers, women, and employees over 45 are more likely to commute by car, while those with higher education levels are less inclined to do so. The study also simulates policy scenarios, including location- and time-dependent parking fees and public transport subsidies, to assess their impact on mode choice. The findings identify target groups most likely to adjust their commuting behavior, enabling the design of tailored interventions. This research offers practical insights to help companies achieve their sustainability goals while mitigating the significant environmental impact of employee commuting.

Ihab Kaddoura

Quantifying Future Mobility: Scenario-Based Analysis with Agent-Based Modeling

Thomas Hettinger (SBB), Ihab Kaddoura (SBB), Annick Noll (SBB), Merlin Unterfinger (SBB), Joschka Bischoff (SBB)

By 2050, Switzerland's mobility landscape will face increasing passenger and freight demands, requiring more efficient and flexible transportation solutions. Switzerland's integral timetable has long been the backbone of public transport. This study examines various concepts for future mobility, including the replacement of the integral timetable with a metro-like system featuring more frequent, faster, and more flexible services. Using an advanced agent-based modeling framework, we quantify the impact of such transformations by capturing individual mobility behavior and system-wide effects.

We evaluate multiple scenarios, considering how changes in the train schedule, stop pattern, first/last-mile connectivity and regulatory measures influence modal shift, travel times, and network efficiency. The results reveal that new schedule concepts, improved first/last-mile services, and accompanying regulatory measures increase the overall public transit modal share. While most simulated passengers benefit from these changes, trade-offs remain, particularly as we deviate from traditional planning principles, which may lead to longer travel times or additional transfers.

Our findings highlight the importance of dynamic simulations in navigating the complexities of future transport planning. This approach enables policymakers to quantify synergies and trade-offs across competing strategies. By leveraging agent-based simulation and multimodal scenario analysis, we provide a robust decision-support tool for designing resilient transport systems.

Session 3B

Reyhaneh Hosseininejad

Multimodal Human Motion Forecasting, From Local to Global

Reyhaneh Hosseininejad (EPFL-VITA), Megh Shukla (EPFL-VITA), Saeed Saadatnejad (EPFL-VITA), Mathieu Salzmann (EPFL-CVLAB), Alexandre Alahi (EPFL-VITA)

Human pose forecasting is inherently multimodal, as different future poses can emerge from the same initial motion. We first introduce MotionMap, a heatmap-based representation to capture this multimodality by modeling spatial distributions over possible future poses, where different local maxima correspond to distinct motion modes. This approach enables efficient sampling of diverse predictions and provides a measure of confidence for each possible motion outcome. We extend MotionMap beyond local pose forecasting to also predict multimodal global trajectories, capturing how different pose sequences lead to diverse motion paths through space. By modeling the relationship between local motion and global movement, our approach ensures that predicted trajectories remain coherent while preserving multimodality. We introduce an enhanced representation that efficiently captures trajectory distributions without excessive sampling, allowing for uncertainty quantification and controllability over the predicted motion. Through extensive evaluations on large-scale 3D motion datasets, we

demonstrate the effectiveness of our method in producing diverse and structured global motion forecasts, advancing human motion prediction for applications in autonomous systems, virtual environments, and human-robot interaction.

Anne-Valérie Preto

Differentiation of Modal Preferences in Public Transportation

Anne-Valérie Preto (EPFL-TRANSP-OR), Antonin Danalet (SBB), Joschka Bischoff (SBB), Negar Rezvany (EPFL-TRANSP-OR), Fabian Torres (EPFL-TRANSP-OR), Michel Bierlaire (EPFL-TRANSP-OR)

Rail and light-rail is often preferred over bus due to their higher level of service and better readability. This rail or light-rail bonus indicates a user preference for rail-based systems even when service levels are comparable. However, quantifying this preference remains challenging. Stated and revealed preference (SP/RP) surveys struggle to capture the complexity of this behavior. Additionally, constant recalibration of alternative-specific constants (ASCs) is necessary for accurate modeling.
We address these challenges by using observed count data to differentiate public transport modes in Lausanne, Switzerland. The calibration and validation of constants for different modes ensures the model accurately captures modal preferences in SIMBA MOBi, the activity-based, agent-based demand model of the Swiss Federal Railways. The refined model was tested with Lausanne and Zürich data. The results confirm a preference for light rail over buses. The enhanced model accurately predicts passenger demand and mode preferences, capturing competition between bus and light rail. It demonstrates its potential to estimate the impact of new transit infrastructure.

Sebastiano Papini

Mapping Cycling-Specific Infrastructure Using Object Detection on Remotely Sensed Images

Sebastiano Papini (ETH-D-MTEC-CAE), David Zani (ETH-IBI-IM)

The new Cycle Route Act (2020) aims to significantly expand Swiss cycling infrastructure within a decade. However, in stark contrast to this policy agenda, from a research perspective the lack of comprehensive data on cycling infrastructure is a significant barrier, particularly for studying the impact of infrastructure modifications on a junction-specific granularity (e.g. on induced cycling demand or crash risks). Existing data suffers from at least one of the following deficiencies: (1) fragmentation along administrative borders, (2) purely link-oriented data without information on junctions, (3) missing information on historical infrastructure changes, and (4) inadequate categorization from a road design perspective. The contribution of this paper is therefore threefold. First, a object detection method is utilized on aerial imagery to generate a dataset that addresses all four previously mentioned issues. For this purpose, we train a YOLOv8 (You Only Look Once, version 8) model, a common deep learning architecture for object detection, to detect 18 different cycling-specific infrastructure features. Second, it is demonstrated that the method is valid by comparing a subset of the resulting data set to an external communal level data set. Third, the overall historical development of cycling-specific infrastructure in the ten largest Swiss agglomerations is discussed.

Session 3C

Katja Schimohr

Household shopping trips: exploring travel patterns and links to the built environment

Katja Schimohr (ETH-IVT-TMP), Giulio Mattioli (TU Dortmund), Eva Heinen (ETH-IVT-TMP)

Shopping is one of the most common trip purposes. Shopping also holds significant potential for active mode use as trip distances tend to be (or could be) short. While an association between shopping behavior and built environment characteristics can be assumed, this relationship has received limited research attention so far. Further, shopping tends to be habitual behavior and, as a maintenance task, is distributed within households. Therefore, this study aims to identify different shopping behavior typologies of households and investigates the spatial and personal factors associated with these patterns. Using trip data from the 2022 German Mobility Panel (MOP), a nationwide and representative 7-day travel diary survey, we conduct a cluster analysis. Key variables to capture transport-related aspects of shopping behavior include mode choice, trip distance, trip frequency, and trip chaining. The analysis reveals four distinct household shopping patterns. A multinomial regression analysis is performed to identify the individual, household, and spatial determinants of cluster membership. The findings allow to better understand different typologies of household shopping behavior. They provide insights into whether built environment factors, such as proximity to shopping destinations, primarily shape household shopping trips or whether individual preferences and constraints play a stronger role.

Elisabeth Brugger

Understanding SBBs Timetabling KPIs

Elisabeth Brugger (ETH-IVT-TS), Paola Pellegrini (Université Gustave Eiffel), Francesco Corman (ETH-IVT-TS)

Timetabling is an essential task of railway systems. Under the pressure of increasing demand for railway networks, academia has worked in these last decades on the modeling and solving of this task. To be truthful to reality, models must consider the interests of the involved stakeholders and account for technical conditions. Satisfying these different interests leads to several contradictory objectives. The weighted sum of the objectives is a common way to cope with a multi-objective problem. However, extensive studies on weight choice are lacking in the railway literature. The Swiss National Railway (SBB) has confirmed its interest in a deeper understanding of its objectives and their weights in the objective function. This paper studies the Pearson correlation between the objectives. Over a hundred scenarios are generated from three SBB corridors. The results show that no linear correlation is consistent over multiple corridors. Further research to understand the objectives' higher-order interactions and the weight choice is envisaged.

Anna S. Reiffer

Understanding Barriers to Active Lifestyles: Analyses of Active Travel and Exercise in Multiweek Time Use and Travel Diary Data

Anna S. Reiffer (ETH-IVT-TMP), Eva Heinen (ETH-IVT-TMP)

Physical activity is vital for health, and active travel can help individuals stay active. However, barriers such as time constraints and limited access hinder regular exercise or active commuting. This study leverages data from the TimeUse+ survey, a multiweek survey of time use and travel. We apply discrete and multiple discrete choice models to evaluate sociodemographic characteristics and time use patterns, respectively, to assess respondents' activity levels and identify levers to promote active lifestyles.
Our results show that while those who regularly meet recommended activity levels do so through exercise, to a large extend active travel prevents people from leading an otherwise sedentary lifestyle. Our analyses further show that the more time spent on unpaid work allows people to spend less time on active travel and exercise. This is even more pronounced for those with young children in the household. Telecommuting is positively associated with spending more time on exercising, however, only for those who do not have children.
This study identifies nuanced barriers to active lifestyles while accounting for differences in both sociodemographic and activity time use patterns. The results can help inform policies to promote active lifestyles across diverse populations.

Sessions 4: Thursday, May 15th 2025

Sessions 4				
Chair	Kevin Riehl (ETH-IVT-SVT)	**Session 4A**		
Room	Auditorium			
No.	**Start**	**End**	**Speaker**	**Title**
4.1	13:30	13:55	Marija Kukic (EPFL-TRANSP-OR)	Simulation Framework for Longitudinal Synthetic Population Generation
4.2	13:55	14:20	Benjamin Gramsch-Calvo (ETH-IVT)	Going the Extra Mile: Estimating the Willingness to Travel to Meet With Friends Using a Joint Destination Choice Model
4.3	14:20	14:45	Minru Wang (EPFL-LUTS)	Profit maximization for Pickup and Delivery Problem with Time Windows using drones and scheduled lines
4.4	14:45	15:10	Kevin Riehl (ETH-IVT-SVT)	Oriented Object Detection For Aerial Vehicle Trajectory Extraction
Chair	Pengbo Zhu (EPFL-LUTS)	**Session 4B**		
Room	Sala Balint			
No.	**Start**	**End**	**Speaker**	**Title**
4.5	13:30	13:55	Nina Wiedemann (ETH-IKG)	Bridging prediction and optimization in on-demand transportation systems with Optimal Transport
4.6	13:55	14:20	Nicola Ortelli (TPG)	Mode-specific multimodal transfer penalties: insights from a stated-preference experiment in Geneva
4.7	14:20	14:45	Pavel Ilinov (EPFL-TRANSP-OR)	Keep it Simple: Addressing Rare Events in Data Synthesis Using Beta Divergence
4.8	14:45	15:10	Pengbo Zhu (EPFL-LUTS)	Vehicle to Power Grid: Optimal Scheduling of Battery Swapping for On-demand EV Fleets
Chair	Lucas Meyer de Freitas (ETH-IVT-VPL)	**Session 4C**		
Room	Sala Eranos			
No.	**Start**	**End**	**Speaker**	**Title**
4.9	13:30	13:55	David Zani (ETH-IBI-IM)	Creating network-wide overviews of infrastructure costs and crash risk in early planning stages
4.10	13:55	14:20	Mohammadali Zayandehroodi (ETH-IVT-SVT)	Evaluating Safety Countermeasures at Highway-Railway Grade Crossings: A Review
4.11	14:20	14:45	Lan Feng (EPFL-VITA)	Data Scaling and Selection in Autonomous Driving
4.12	14:45	15:10	Lucas Meyer de Freitas (ETH-IVT-VPL)	Exploring the substitution potential from car trips towards bikes and e-bikes through radical policies: First results

Sessions 4 - abstracts

Session 4A

Marija Kukic

Simulation Framework for Longitudinal Synthetic Population Generation

Marija Kukic (EPFL–TRANSP–OR), Michel Bierlaire (EPFL–TRANSP–OR)

This paper introduces a novel framework for generating longitudinal synthetic populations that track individuals over time, addressing limitations of traditional snapshot-based synthetic population methods. We propose a Gibbs sampler-based approach that combines models and cross-sectional data to generate universal, time-independent variables, which enable the consistent derivation of time-specific synthetic populations at any point in time. A key advantage of this framework is that any changes to the universal dataset are automatically reflected in derived datasets, allowing for efficient scenario testing. The methodology is demonstrated using Swiss Mobility and Transport Microcensus data, by simulating the impacts of hypothetical events such as pandemics. This approach ensures temporal consistency, captures individual-level dynamics, and reduces the computational burden of regenerating populations, showcasing its potential for activity-based modeling and long-term policy analysis when real longitudinal data is unavailable.

Benjamin Gramsch-Calvo

Going the Extra Mile: Estimating the Willingness to Travel to Meet With Friends Using a Joint Destination Choice Model

Benjamin Gramsch-Calvo (ETH-IVT), Koki Okamura (The University of Tokyo), Kiyoshi Takami (The University of Tokyo), Yuki Oyama (The University of Tokyo), Makoto Chikaraishi (Hiroshima University), Kay W. Axhausen (ETH-IVT-VPL), Giancarlos Parady (The University of Tokyo)

Most leisure activities are performed jointly with friends or family, therefore the decision on where to travel highly depends on the negotiation process between the individuals participating. To analyze this phenomenon, we have developed a joint destination choice model that integrates the group's travel impedance on the decision. The model allows us to estimate the trade-off between the individual's and group's travel time, showing that people on average are willing the travel 1 minute less to reduce the group's travel time by 0.39 minutes. Later, we compared the out-of-sample predictive power of our model with a simple model that considers only the individual's travel time, showing that the latter model tends to underestimate kilometers traveled. The results show the importance of considering social networks in destination choice when such models are used for transport policy and agent-based simulations; if the models only consider the ego as the decision maker, the total kilometers traveled are going to be vastly underestimated.

Minru Wang

Profit maximization for Pickup and Delivery Problem with Time Windows using drones and scheduled lines

Minru Wang (EPFL-LUTS), Nikolas Geroliminis (EPFL-LUTS)

On-demand drone delivery can efficiently transport packages in an urban environment without contributing to road congestion. When a package's journey is partially carried out on a scheduled bus line, the delivery service provider can reduce service costs by exploiting underutilized capacity on ground vehicles, and prevent excessive drone disturbance in urban areas. While some customers are willing to pay a fixed fee to receive their package as soon as possible, other customers do not have any time window preference. In this work, we examine how a delivery platform can optimize the combined drone and bus delivery segments to maximize its profit.

Kevin Riehl

Oriented Object Detection For Aerial Vehicle Trajectory Extraction

Kevin Riehl (ETH-IVT-SVT), Shaimaa El-Baklish (ETH-IVT-SVT), Anastasios Kouvelas (ETH-IVT-SVT), Michail Makridis (ETH-IVT-SVT)

Vehicle trajectories offer valuable insights for a wide range of road transportation applications and research fields. A growing branch of literature explores vehicle trajectory extraction from aerial videos, where object detection using neural networks is an important component. Horizontal bounding box object detection struggles to differentiate well between rotated vehicles, especially when dealing with complex backgrounds or densely packed vehicles. In this work, we demonstrate how oriented object detection and the use of angular, directional information can be used to significantly improve the quality of extracted trajectories. The benchmark of 18 object detection models on a real world video dataset shows, that oriented object detection achieves 0.20m (15%) better internal, and 0.75m (20%) better platoon consistency; REDET and S2A from the openmmlab family count amongst the best performing detection models. Additionally, the analysis of synthetic trajectories with different levels of noise and coverage highlights, that improvements with angular information can be achieved when positional noise is high, coverage is low. At the presence of very noisy angular information however, these improvements diminish.

Session 4B

Nina Wiedemann

Bridging prediction and optimization in on-demand transportation systems with Optimal Transport

Nina Wiedemann (ETH-IKG), Théo Uscidda (CREST – ENSAE), Martin Raubal (ETH – D-BAUG)

Predictions for on-demand transportation services are oftentimes motivated by the possibility to enhance operational efficiency. For example, bike-sharing demand prediction aids in relocation planning. However, the prediction accuracy is usually evaluated with standard

metrics such as the root-mean-squared-error (RMSE), which fall short in assessing the value of predictions for downstream tasks. Since standard metrics treat spatial locations independently, they disregard the costs stemming from the spatial displacement of the predicted demand, such as relocation costs. We put forward Optimal Transport (OT) as a spatial evaluation metric and loss function to bridge the gap between prediction and optimization in transport applications. The proposed framework, GeOT, evaluates prediction models by quantifying the transport costs associated with their prediction errors. Through case studies on bike sharing data, we show that 1) OT better captures spatial costs than existing metrics, 2) OT enhances comparability across spatial and temporal scales, and 3) using OT as a loss function effectively reduces spatial costs. The method is broadly applicable to spatiotemporal prediction tasks, and we provide an open-source Python package for seamless adoption.

Nicola Ortelli

Mode-specific multimodal transfer penalties: insights from a stated-preference experiment in Geneva

Nicola Ortelli (TPG), Elisa Maria Tirindelli (TPG, EPFL-LASUR), Daniel J. Reck (TPG, EPFL-LASUR)

Besides additional walking and waiting times, transfers in multimodal urban transportation networks involve an additional penalty associated with the inconvenience of interrupting one's trip. This value, referred to as pure transfer penalty (PTP), has received an increasing amount of attention in the recent literature (e.g., Garcia-Martinez et al., 2018; Jara-Diaz et al., 2022; Yap et al., 2024) due to its importance in the design of efficient transit, as well as in the development of realistic agent-based simulation models and transportation system digital twins. In this study, we present an analysis of the data obtained from a stated-preference binary route-choice survey conducted in Geneva, Switzerland, in 2024, aimed at evaluating the intermodal PTPs associated with a variety of transport-mode pairs, including emerging modes such as bike-sharing. We develop a series of logit models under distinct assumptions, incorporating socioeconomic characteristics and random panel effects to account for observed and unobserved heterogeneity among respondents. The obtained values of PTP are compared with existing literature to assess their consistency and relevance. These are the first PTP estimates for trips that involve emerging modes, as well as the first mode-specific PTP estimates for Geneva and, to the best of the authors' knowledge, for Switzerland.

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Pavel Ilinov

Keep it Simple: Addressing Rare Events in Data Synthesis Using Beta Divergence

Pavel Ilinov (EPFL-TRANSP-OR), Michel Bierlaire (EPFL-TRANSP-OR)

The iterative proportional fitting (IPF) algorithm remains one of the most widely used tools for generating synthetic data. In this paper, we address the "zero problem" inherent to IPF. Recognizing that IPF solves a well-defined convex problem with affine constraints, we modify the objective by introducing Beta divergence, which generalizes the original problem as a special case. This approach effectively mitigates the zero problem and improves the performance of synthetic data generation.

Pengbo Zhu

Vehicle to Power Grid: Optimal Scheduling of Battery Swapping for On-demand EV Fleets

Pengbo Zhu (EPFL-LUTS), Nikolas Geroliminis (EPFL-LUTS)

Electric vehicles (EVs) offer benefits such as zero tailpipe emissions, lower operating costs, and reduced noise pollution. However, battery energy constraints pose significant challenges for on-demand vehicle operation. Battery swapping—replacing a depleted battery with a fully charged one in minutes—emerges as a promising solution. This work optimizes swapping schedules for on-demand EV fleets using dynamic programming for battery charging strategies that avoid peak electricity usage while considering storage capacity constraints. Numerical simulations verify that the proposed framework reduces electricity costs and enhances service quality compared to conventional EV charging methods.

Session 4C

David Zani

Creating network-wide overviews of infrastructure costs and crash risk in early planning stages

David Zani (ETH-IBI-IM), Bryan T. Adey (ETH-IBI-IM)

Many cities aim to transition their mobility systems toward more sustainable and safer active modes, such as cycling. This involves modifying road space to improve safety and attractiveness for cyclists. However, gaining an overview of the costs and benefits of such modifications is challenging due to limited spatially explicit data about road infrastructure. These data are labor-intensive to collect across entire urban networks. Decision makers rely on such data for evidence-based planning, especially in early planning stages.
This paper aims to address part of this challenge. The paper presents an approach that provides a preliminary network-wide overview of existing road space, road space modification costs, and crash risk. Using Zurich City as an example, the approach combines: (1) a machine learning model to analyze aerial images and generate a spatial overview of road space; (2) cost estimates for infrastructure modifications based on this overview; and (3) crash risk changes associated with the proposed modifications.

The approach offers planners and decision-makers an overview to quickly assess potential trade-offs and benefits of road network transitions, considering costs, safety, and available road space. By providing this overview early in the planning process, the approach promotes sustainable and evidence-based mobility development in urban areas.

Mohammadali Zayandehroodi

Evaluating Safety Countermeasures at Highway-Railway Grade Crossings: A Review

Mohammadali Zayandehroodi (IUST, ETH-IVT-SVT), Barat Mojaradib (IUST), Morteza Bagheri (IUST), Anastasios Kouvelas (ETH-IVT-SVT)

Highway-railway grade crossings (HRGCs) are critical locations where road traffic crosses railways, posing a significant safety risk. This paper reviews the various safety countermeasures implemented at HRGCs. The study investigates the application of the Collision Modification Factor (CMF) concept in assessing the safety at HRGCs, exploring robust assessment methodologies such as cross-sectional and before-and-after models. An overview of CMFs at HRGC is given, including considerations regarding data and strengths and weaknesses of each technique. Review revealed that observational Before–After (BA) studies utilizing the Empirical Bayes (EB) and Full Bayes (FB) approaches offer improved consistency and accuracy in estimating safety countermeasures effectiveness. The findings underscore the importance of comprehensive data analysis and the need for robust models to accurately estimate CMFs and improve safety at HRGCs. The review concludes with a discussion on future research directions to enhance the effectiveness of safety countermeasures at these critical HRGCs.

Lan Feng

Data Scaling and Selection in Autonomous Driving

Lan Feng (EPFL-LUTS), Mohammadhossein Bahari (EPFL-LUTS), Kaouther Messaoud (EPFL-LUTS), Éloi Zablocki (Sorbonne University), Matthieu Cord (Sorbonne University), Fan Nie (Stanford University), Yuejiang Liu (Stanford University), Alexandre Alahi (EPFL-LUTS)

Understanding the impact of data scaling and selection is crucial for advancing vehicle trajectory prediction in autonomous driving. In this work, we introduce UniTraj, a unified framework that integrates multiple real-world and synthetic trajectory datasets to analyze generalization across domains. Our findings reveal a scaling law in trajectory prediction, where model performance improves predictably with increasing data size, akin to trends observed in other machine learning domains. Beyond scaling, we investigate data selection using an optimal transport-based framework, aiming to identify the most valuable data for a given target domain. Our results demonstrate that strategically selected subsets not only reduce computational costs but also outperform models trained on the entire dataset in the target domain. These findings highlight the importance of intelligent data selection strategies in improving motion prediction efficiency and generalization, offering insights for more robust and scalable autonomous driving systems.

Lucas Meyer de Freitas

Exploring the substitution potential from car trips towards bikes and e-bikes through radical policies: First results

Lucas Meyer de Freitas (ETH-IVT-VPL), Shlomo Bekhor (Technion - Israel Institute of Technology), Kay W. Axhausen (ETH-IVT-VPL)

This study applies MNL and Integrated Choice and Latent Variable (ICLV) models to study the mode-shift potentials from cars towards bikes and e-bikes. The results reveal improved model fit of the ICLV. A structural model construct with a random latent variable captures the variance differences between Revealed Preference (RP) and Stated Preference (SP) models. This model also shows that car ownership, particularly the type of car, is the most influential factor for attitudes towards mode-choice and policy preferences, offering deeper insights into transport policy preferences and the willingness to shift away from cars compared to pure sociodemographic factors. The latent variable strongly influences preferences for cycling policies, such as expanding bike networks at the expense of parking. Furthermore, we present a novel cycling infrastructure share interaction term which captures existing cycling infrastructure information at a trip level and successfully incorporate it in the estimation of our models. Besides the contributions mentioned above, we also present a novel online based method for trip diary data collection.

Sessions 5: Thursday, May 15th 2025

Sessions 5				
Chair	Shaimaa El-Baklish (ETH-IVT-SVT)	**Session 5A**		
Room	Auditorium			
No.	**Start**	**End**	**Speaker**	**Title**
5.1	15:40	16:05	Jing Shan (ETH-D-MTEC)	Responding to Supply Chain Disruptions with Coopetition in the Intercontinental Freight Network
5.2	16:05	16:30	Myriam Pham-Truffert (Universität Bern-CDE, UZH- DSI)	Public perception of the urban transport system transformation including electric and automated vehicles
5.3	16:30	16:55	Shaimaa El-Baklish (ETH-IVT-SVT)	Koopman Mode Decomposition for Short-term Traffic Prediction
Chair	Kaouther Messaoud (EPFL-VITA)	**Session 5B**		
Room	Sala Balint			
No.	**Start**	**End**	**Speaker**	**Title**
5.4	15:40	16:05	Negar Rezvany (EPFL-TRANSP-OR)	Integrating housing and transport interactions: A strategic dynamic approach
5.5	16:05	16:30	Ran Chen (EPFL-LUTS)	Equilibrium Analysis of Vehicle Allocation in Competitive Multi-Regional Ride-Hailing Markets
5.6	16:30	16:55	Kaouther Messaoud (EPFL-VITA)	Self-Supervised Multi-Task Learning via Cross-Modal Implicit Joint-Embedding Predictive Architecture
Chair	Tom Haering (EPFL-TRANSP-OR)	**Session 5C**		
Room	Sala Eranos			
No.	**Start**	**End**	**Speaker**	**Title**
5.7	15:40	16:05	Jan Lordieck (ETH-IVT-TS)	Informing Platform Crowding Prediction with Variable Relationships obtained from Convergent Cross Mapping
5.8	16:05	16:30	Prunelle Vogler (EPFL-TRANSP-OR)	An Event-based modeling approach for the Mutliagents Daily Scheduling Problem
5.9	16:30	16:55	Tom Haering (EPFL-TRANSP-OR)	BHAMSLE: A Breakpoint Heuristic Algorithm for Maximum Simulated Likelihood Estimation of Advanced Discrete Choice Models

Sessions 5 - abstracts

Session 5A

Jing Shan

Responding to Supply Chain Disruptions with Coopetition in the Intercontinental Freight Network

Jing Shan (ETH-D-MTEC), Stephan Wagner (ETH-D-MTEC)

Driven by factors such as geopolitical conflicts, natural disasters, pandemics, or accidents, global shipping routes and supply chains are increasingly disrupted. Coopetition among different transport modes helps mitigate these disruptions by providing alternative modes as backup options. Intercontinental Eurasian rail freight has emerged as a vital alternative to maritime shipping, playing a crucial role in mitigating the risks associated with disruptions in maritime transport. However, existing research typically examines each transport mode independently. This paper lays the groundwork for advancing research in intercontinental multimodal freight transport by introducing the Intercontinental Multimodal Scheduled Service Network Design (IM-SSND) model to analyze Eurasian freight flows. The model captures the coopetition among transport modes that both compete and cooperate to serve the supply chain. In doing so, it enhances supply chain resilience amid geopolitical disruptions. Our findings show that the Red Sea crisis triggers a significant mode shift from maritime shipping to intercontinental rail, especially for time-sensitive goods. The findings also reveal that the existing Eurasian rail freight network cannot fully absorb the delays caused by the crisis, indicating that the capacity of the rail network needs to be expanded. In addition, train length significantly influences network profit; while longer trains also improve operational efficiency, they may also result in increased unused residual capacity (unoccupied booking spaces on train services). These findings highlight that the IM-SSND model serves as both a strategic and operational planning tool, enabling policymakers and logistics providers to better respond to disruptions in intercontinental multimodal freight transport.

Myriam Pham-Truffert

Public perception of the urban transport system transformation including electric and automated vehicles

Myriam Pham-Truffert (Universität Bern-CDE, UZH- DSI), Mario Angst (UZH- DSI), Maria J. Santos (UZH- GEO)

Future urban transport mobility is likely to include more Electric Vehicles (EVs) and Automated Vehicles (AVs). In this study, we ask "How do citizens perceive that EVs and AVs would influence urban transport systems?" Our survey data (n = 698) comprises full answers from citizens living in the five largest Swiss agglomerations and randomly assigned to control and experimental groups. We collected Likert scale assessments of positive or negative interactions between four objectives of urban transport systems (transport infrastructure, road safety, transport affordability, and climate-friendliness) from the perspective of different transport modes (bikes, cars, and public transport). The treatment groups were prompted to answer the questions either imagining living in a world where (1) all gasoline-powered vehicles would have been replaced by electric vehicles (testing the role of EVs), or where (2) all vehicles would have become self-driving vehicles (testing the role of AVs). We test plausible

hypotheses based on the current state of knowledge and compare the treatment groups' assessments with the control group's using Bayesian multilevel regression models. Preliminary results suggest that citizens perceive urban transport systems could transform with (i) effective climate mitigation effects through electrification, and with (ii) differentiated safety development depending on transport modes through automation.

Shaimaa K. El-Baklish

Koopman Mode Decomposition for Short-term Traffic Prediction

Shaimaa K. El-Baklish (ETH-IVT-SVT), Michail A. Makridis (ETH-IVT-SVT), Anastasios Kouvelas (ETH-IVT-SVT)

Traffic flow data exhibits temporal and spatial correlations and a dynamic sequential structure; therby making short-term prediction challenging. This study explores the application of the Koopman operator for traffic prediction, which transforms a nonlinear system into a linear one in an infinite-dimensional space. The data-driven nature of Koopman mode decomposition (KMD) enables it to effectively capture these spatio-temporal correlations, making it well-suited for traffic prediction. Specifically, we incorporate known spatio-temporal inter-dependencies in traffic flow to develop a physics-informed modeling pipeline. A comparison between KMD and its linear counterpart, dynamic mode decomposition (DMD), demonstrates that KMD yields more accurate predictions and handles a wider range of traffic scenarios. Future research focuses on improving the robustness of KMD by addressing challenges related to missing and noisy data, further enhancing its applicability in real-world traffic prediction.

Session 5B

Negar Rezvany

Integrating housing and transport interactions: A strategic dynamic approach

Negar Rezvany (EPFL-TRANSP-OR), Frédéric Docquier (LISER, Luxemburg), Tim Hillel (UCL, UK), Michel Bierlaire (EPFL-TRANSP-OR)

Urban areas face challenges like traffic congestion and resident relocation, underscoring the need for tools to manage the complex relationship between transport and land-use. Land-use Transport Interaction (LUTI) models explore these interrelations. In traditional approaches, transitions between future states are often overlooked. Capturing time lags between urban processes—such as travel mode changes (fast), residential relocation (medium), and infrastructure developments (slow)- is particularly challenging. We propose a dynamic simulation model over a multi-year horizon, explicitly capturing feedbacks between transport and land-use within a unique framework. Our approach is based on the principles of System Dynamics, which is well-suited for modelling complex systems but remains underutilised in LUTI research. Model application is showcased by an illustrative example, simulating residents' travel and residential location choice behaviour in a region. The framework can evaluate various policies, offering valuable insights for transport and urban planning.

Ran Chen

Equilibrium Analysis of Vehicle Allocation in Competitive Multi-Regional Ride Hailing Markets

Ran Chen (EPFL-LUTS), Nicolas Geroliminis (EPFL-LUTS)

This study presents a comprehensive model to analyze ride-hailing markets where multiple companies strategically allocate their vehicle fleets across various regions to maximize pro its. We formulate the problem as a classical multi-player, non-cooperative game with co pling constraints on the actions of each company. Despite the non-convex nature of the constraints, which preclude guarantees of a unique Nash equilibrium, we propose an iterative algorithm to compute equilibria and analyze the region of convergence. Utilizing this algorithm, we conduct a numerical study illustrating the model in a duopoly market comprising two regions with distinct demand profiles.

Kaouther Messaoud

Self-Supervised Multi-Task Learning via Cross-Modal Implicit Joint-Embedding Predictive Architecture

Kaouther Messaoud (EPFL-VITA), Mohamed Abdelfattah (EPFL-VITA), and Alexandre Alahi (EPFL-VITA)

Self-supervised learning has gained significant traction for its ability to leverage vast amounts of unlabeled data across diverse modalities. In this work, we introduce a Cross-Modal Implicit Joint-Embedding Predictive Architecture (Cross-Modal I-JEPA) for multi-task learning, enabling robust cross-modality understanding across text, video/image, and skeleton data. Unlike traditional supervised approaches that rely on task-specific labeled datasets, our method learns holistic representations by aligning implicit embeddings across modalities without explicit reconstruction.
Our framework leverages a multi-modal encoder-decoder structure that captures shared and modality-specific features, enabling joint training for multiple downstream tasks, including action recognition, keypoint estimation, and object detection. Through cross-modal contrastive alignment and a predictive learning objective, Cross-Modal I-JEPA facilitates knowledge transfer across modalities, improving generalization and sample efficiency. Extensive experiments demonstrate state-of-the-art performance across diverse benchmarks, highlighting the effectiveness of our method in multi-modal, multi-task self-supervised learning.
Our findings suggest that implicit predictive modeling across modalities enhances feature abstraction, making it a promising paradigm for scalable and adaptable learning in multi-modal environments.

Session 5C

Jan Lordieck (ETH-IVT-TS)

Informing Platform Crowding Prediction with Variable Relationships obtained from Convergent Cross Mapping

Jan Lordieck (ETH-IVT-TS), Riccardo Fiorista (MIT – Urban Mobility Lab), Anson Stewart (MIT – Urban Mobility Lab), Francesco Corman (ETH-IVT-TS)

Temporal and spatial mismatch of demand and supply in mobility systems, perceived by riders as crowding, often entail unexpected rippling effects throughout the entire urban transportation network. Existing methodologies often perform well in predicting regular station or platform occupancy but fail to correctly predict tail events, i.e. crowding. The approach of this work is twofold. First, a stochastic gradient boosted tree regression model is constructed utilizing operational and exogenous data (automatic fare collection, rail movement, historic values, and weather), exposing the model to potential drivers of irregular high demand. Second, by analyzing historic timeseries of platform occupancy with convergent cross mapping, causal relationships between the occupancy of different stations as well as their influence lags are derived. Lagged values of these variables are then used in the regression model to predict crowding at specific platforms. We identify strong causal relationships between upstream and downstream as well as interchange stations, adding explanatory power to the prediction model. We compare the prediction results of the causality informed model with the baseline prediction of the original model and the pure simplex prediction solely based on historic data.

Prunelle Vogler

An Event-based modeling approach for the Mutliagents Daily Scheduling Problem

Prunelle Vogler (EPFL-TRANSP-OR), Frédéric Meunier (ENPC- CERMICS), Michel Bierlaire (EPFL-TRANSP-OR)

This paper proposes a new formulation of the Daily Scheduling Problem for a group of agents. This involves planning the activities and trips of a group of agents over a day, which can then be used as the basis for activity-based models to forecast transport demand. The agents belong to the same social group, e.g. a family, and therefore maximize the sum of their utilities. This problem is designed to be as flexible as possible: some activities are mandatory for some agents, others require a certain group of people to be performed, several locations are possible for an activity, and some activities have a maximum capacity. The event-based modeling that we introduce enables to model this problem as a minimum cost flow problem with additional constraints, notably for temporal consistency. We present various applications of this model. We compare the performance of this model with previous models of this problem.

Tom Haering

BHAMSLE: A Breakpoint Heuristic Algorithm for Maximum Simulated Likelihood Estimation of Advanced Discrete Choice Models

Tom Haering (EPFL-TRANSP-OR), Michel Bierlaire (EPFL-TRANSP-OR)

This paper introduces BHAMSLE, a Breakpoint Heuristic Algorithm for Maximum Simulated Likelihood Estimation (MSLE), adapted from the Breakpoint Heuristic Algorithm (BHA) for choice-based pricing, bridging the gap between choice-based optimization and choice model estimation. Similarly to the BHA, BHAMSLE leverages indifference points—or breakpoints—in individual decision-making to systematically explore local optima. Benchmark comparisons with CMA-ES (Covariance Matrix Adaptation Evolution Strategy), a state-of-the-art global optimization algorithm, demonstrate that BHAMSLE is able to identify high-quality starting points that guide Pandas Biogeme, the leading software for DCM estimation, to significantly

better solutions compared to those obtained with CMA-ES or standard initialization. Estimations of four latent class logit and mixed logit models across 100 random samples show log-likelihood gains of up to 10% for observed choices and 16% for synthetically generated choices.

Sessions 6: Friday, May 16th 2025

Sessions 6				
Chair	Basil Schmid (ARE)	**Session 6A: Improving on-demand transport**		
Room	Auditorium			
No.	**Start**	**End**	**Speaker**	**Title**
6.1	09:00	09:25	Jean-Michel Henchoz (FEDRO)	Potential and importance for R&D of a National Access Point for transport data: Status and Expected developments
6.2	09:25	09:50	Davi Guggisberg (SBB)	Integrating Machine Learning and MATSim for High-Granularity Passenger Load Predictions at SBB
6.3	09:50	10:15	Basil Schmid (ARE)	Stated preference (SP) survey 2025 on mode, route and departure time choice
Chair	Weijiang Xiong (EPFL-LUTS)	**Session 6B: Behaviour change**		
Room	Sala Balint			
No.	**Start**	**End**	**Speaker**	**Title**
6.4	09:00	09:25	Mingjia He (ETH-IDSC)	Game-Theoretic Resource Allocation for Multi-Stakeholder Transportation Networks
6.5	09:25	09:50	Ying-Chuan Ni (ETH-IVT-SVT)	Congestion-aware optimization of urban road space allocation for cars and bicycles
6.6	09:50	10:15	Weijiang Xiong (EPFL-LUTS)	Multimodal Probabilistic Urban Traffic Forecasting
Chair	Jonas Meli (ETH-IVT-TMP)	**Session 6C: Deep-learning**		
Room	Sala Eranos			
No.	**Start**	**End**	**Speaker**	**Title**
6.7	09:00	09:25	Mariam Hassan (EPFL-VITA)	GEM: A Generalizable Ego-Vision Multimodal World Model for Fine-Grained Ego-Motion, Object Dynamics, and Scene Composition Control
6.8	09:25	09:50	Marcel Seger (University of Oxford)	Taking charge: Measuring electric vehicle users' propensity to adopt smart charging processes at the workplace
6.9	09:50	10:15	Jonas Meli (ETH-IVT-TMP)	The influence of perceived train barriers on train usage

Session 6 - abstracts

Session 6A

Jean-Michel Henchoz

Potential and importance for R&D of a National Access Point for transport data Status and Expected developments

Jean-Michel Henchoz (FEDRO)

Introduction

R&D in transport need quality data. This is a lasting issue in the transportation field that has found only partial solutions. FEDRO has set-up since couple years a road traffic data platform where not only the data from the national network (i.e. Motorways and some key passes) but potentially all relevant data form the various road operators or private stakeholders in the road sector. At the same time, the Federal Office of Public Transport (OFT/BAV) is leading the federal initiative to build a general National Access Point for transport data called MODI. A legal base proposal is also in preparation to give a frame-work for setting up the needed infrastructure, collecting and storing data.

Presentation Content

This presentation is not directly an R&D activity, but aims to discuss the importance of quality data and the current efforts of the federal administration to gather real-time and historical data of various quality to support internal activities as well as research in the domain.

The presentation aims at:

1. Bringing the attention of the R&D community on the current efforts to generate quality and accessible data in the field of transport.
2. Discuss the current developments at the federal level.
3. Inform on initiatives at cantonal or agglomeration level.
4. Propose an analysis of the needed future development to enrich data for the specific needs of R&D.

Links & Documents

The current "Swiss National Access Point"
Open data platform mobility Switzerland – Open data platform for customer information on Swiss public transport

The Road Traffic Data Platform (FEDRO)
Aktuelle Daten-Plattform für den Strassenverkehr in der Schweiz

The MODI initivative (BAV
Data for an efficient mobility system - FOT

NAPCORE (EU Project)
NAPCORE | National Access Point Coordination Organisation for Europe

ITS Directive & Delegated Acts
ITS Directive and Action Plan - European Commission

Davi Guggisberg

Integrating Machine Learning and MATSim for High-Granularity Passenger Load Predictions at SBB

Davi Guggisberg (SBB), Marcus Riedi (SBB), Livio Kaeslin (SBB), Denis Métrailler (SBB), Marcel Rieser (SBB), Patrick Bützberger (SBB)

Swiss Federal Railways (SBB) has traditionally relied on annual average weekday and weekend Origin-Destination (OD) matrices, paired with representative timetables, to plan major service changes. While this approach has proven successful for strategic planning, new operational and planning requirements demand more granular, accurate, and frequent passenger load forecasts. To address this, two major challenges emerged: the limited availability of passenger counts, and the manual effort required to model and run numerous scenarios. We tackled these challenges by developing a Machine Learning (ML) model that infers missing passenger counts, which in turn are fed into our existing OD matrix estimation method to produce OD matrices for specific periods of the year, capturing seasonal demand variations. Additionally, we automated our transport assignment workflows by transitioning from desktop-based software and manual, labor-intensive processes to a fully automated cloud-based enterprise analytics platform. To this end, we extended MATSim's agent-based routing capabilities into a macroscopic transport assignment tool, allowing for efficient and automated assignment runs in the cloud. As a result, SBB can now reliably produce daily, accurate timetable passenger load forecasts, meeting evolving business needs, including short-term planning and responsiveness to seasonal or event-based demand fluctuations.

Basil Schmid

Stated preference (SP) survey 2025 on mode, route and departure time choice

Basil Schmid (ARE), Sylvie Gayda (STRATEC), Mathilde Ruyssen (STRATEC), Nicolas Moreau (STRATEC), Pauline Quittelier (STRATEC), Marco Kouwenhoven (Significance), Jeroen Muller (Significance), Rodrigo Tapia (Significance), Michel Bierlaire (EPFL), Nicole Mathys (ARE)

As part of the Swiss Mobility and Transport Microcensus (MTMC) 2025, Switzerland's representative travel survey that is conducted every five years, an SP-survey on mode, route and departure time choice is conducted for a subsample of about 4'000 respondents. The aim is to provide an empirical basis for the Swiss national transport model (NPVM), the transport perspectives (VP) as well as the value of time studies to update the cost-benefit norms. This paper presents an overview of the implementation of the SP-survey 2025 and the major changes in the design process.
The SP-tasks are personalized for each respondent based on a revealed preference (RP) trip observed in the MTMC. This ensures that the choice situations are realistic and reduces the risk of hypothetical bias: i) The availability of modes depends on the set of modes available to the respondent, ii) travel costs are calculated to account for PT season ticket ownership and the car type used for the reference trip, iii) trip purpose and distance are used to obtain the SP attribute levels and iv) route and departure time tasks are based on the chosen mode (focus on car or PT) for the reference trip.

Session 6B

Mingjia He

Game-Theoretic Resource Allocation for Multi-Stakeholder Transportation Networks

Mingjia He (ETH-IDSC), Yannik Werner (ETH-IDSC), Andrea Censi (ETH-IDSC), Emilio Frazzoli (ETH-IDSC), and Gioele Zardini (MIT LIDS)

The transportation network design often involves multiple stakeholders with diverse priorities, such as nations within the European railway system or regional entities managing their own networks. However, the lack of coordination in the planning of both cross-border infrastructure and individual networks can lead to inefficiencies and suboptimal outcomes [1–3]. To address this challenge, we consider the system as a hierarchical multi-agent structure, where self-optimized agents allocate their own resources to public investment projects and a higher-level organization utilizes supplemental resources to maximize social welfare and ensure fairness. To support decision-making within this structure, we introduce a game-theoretic investment allocation framework to foster cooperation among agents. By leveraging the Vickery-Clarke-Groves (VCG) mechanism, the framework determines collective investment decisions from the agent's valuations and the necessary payments to achieve fair and efficient outcomes. A numerical experiment conducted on a three-region network demonstrates a 10% improvement in overall network performance while ensuring that all participating agents benefit. A case study on the European railway system will further validate the framework's efficiency.

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2. European Union Agency For Railways, "Cross-border rail transport potential," tech. rep., European Union Agency for Railways, Luxembourg, 2022.
3. E. Medeiros, "Cross-border transports and cross-border mobility in EU border regions," Case studies on transport policy, vol. 7, no. 1, pp. 1–12, 2019.

Ying-Chuan Ni

Congestion-aware optimization of urban road space allocation for cars and bicycles

Ying-Chuan Ni (ETH-IVT-SVT), Adyasha Mohapatra (ETH-IVT-SVT), Michail A. Makridis (ETH-IVT-SVT), Anastasios Kouvelas (ETH-IVT-SVT)

Re-allocating urban road space to bicycles has been considered an effective way to enhance cycling modal share. However, this kind of transport policy often receives strong criticism from the public because of the concern related to severe traffic congestion caused by the reduction of car road space. In view of this problem, this work proposes a simulation-based optimization framework to determine the road space allocation scheme between cars and bicycles for road links in an urban network based on network traffic performance. In the framework, possible lane configurations are first designed for various road categories with different widths. Besides car traffic, bicycle traffic flow considering its distinct non-lane-based dynamics is also considered to avoid congestion on the bike lane network. Given the travel demand pattern, the algorithm aims to maximize the average route-mean speeds

experienced by road users in both traffic modes. A case study is conducted for a small-size network with heavy traffic demand. The results show that the optimal allocation schemes successfully mitigate the negative impact on bi-modal network traffic flow. In addition, the amount of road space allocated to bicycles can be increased as the decrease of car modal share. The proposed framework is particularly crucial for a congested network with limited road space to foster a sustainable urban transport system.

Weijiang Xiong

Multimodal Probabilistic Urban Traffic Forecasting

Weijiang Xiong (EPFL-LUTS), Nikolas Geroliminis (EPFL-LUTS)

Urban traffic forecasting occupies a crucial role in modern Intelligent Transporation System, because the predicted information is an essential ground for traffic management and control. Therefore, the focus of many research works has been predicting a most likely value of the future traffic. However, a point prediction alone can not support good decision making, because urban traffic can evolve into different states from the same starting condition, as a result of its inherent uncertainties and dynamics. In this work, we propose a multi-modal probabilistic traffic forecasting method for an urban transporation sytem, where the model predicts a Gaussian Mixture Distribution for the future traffic. We show that the predictive distribution captures the uncertainties of urban traffic dynamics, and its Bayesian average provides a close estimate of the future traffic. Besides, the Bayesian prediction part can be learned from data in parallel with a classic regression model, and thus making the uncertainty prediction an added value. We hope our method can provide more solid grounds for traffic management and control in modern urban cities.

Session 6C

Mariam Hassan

GEM: A Generalizable Ego-Vision Multimodal World Model for Fine-Grained Ego-Motion, Object Dynamics, and Scene Composition Control

Mariam Hassan (EPFL-VITA), Alexandre Alahi (EPFL-VITA)

World models predict future frames from past observations and actions, making them powerful simulators for ego-vision tasks with complex dynamics, such as autonomous driving. We present GEM, a Generalizable Ego-vision Multimodal world model that predicts future frames using a reference frame, sparse features, human poses, and ego-trajectories. Hence, our model has precise control over object dynamics, ego-agent motion and human poses. GEM generates paired RGB and depth outputs for richer spatial understanding. We introduce autoregressive noise schedules to enable stable long-horizon generations. Our dataset is comprised of 4000+ hours of multimodal data across domains like autonomous driving, egocentric human activities, and drone flights. Pseudo-labels are used to get depth maps, ego-trajectories, and human poses. We use a comprehensive evaluation framework, including a new Control of Object Manipulation (COM) metric, to assess controllability. Experiments show GEM excels at generating diverse, controllable scenarios and temporal consistency over long generations. Code, models,

and datasets are fully open-sourced. Check our website for visualizations https://vita-epfl.github.io/GEM.github.io/.

Marcel Seger

Taking charge: Measuring electric vehicle users' propensity to adopt smart charging processes at the workplace

Marcel Seger (University of Oxford, EPFL-TRANSP-OR), Christian Brand (University of Oxford), Charlie Wilson (IIASA)

Transitioning to electrified mobility requires extensive EV charging infrastructure, particularly at workplaces where 25% of UK car-based travel occurred in 2022 for commuting purposes. Regulatory pressure is driving firms to invest in on-site workplace chargers. Advanced smart charging algorithms are then needed to coordinate power flows to adhere to capacity limits. These power flows can differ substantially subject to the choice of decision objective, ranging from lowering overall peak demand, minimising total costs or emitted carbon emissions. While the workplace as single decision agent tends to prioritise lower peaks, this can come at the risk of overwriting employees' preferences for lowest overall charging costs. To this end, digital service providers, such as Monta or ev.energy, promise to address these coordination problems by building a digital platform, taking into account employees' and workplace operators' preferences equally. While EV commuters' general preferences for smart charging have been studied extensively in the past, we lack empirical understanding of the influence of peoples' digital skills and competencies, access to (digital) infrastructure and levels of trust as mediators for predicting their willingness to adopt smart EV workplace charging technologies. Our work addresses this gap in the literature by computing a large-scale discrete choice experiment with EV workplace commuters in the UK using a hybrid choice model. We find that people with high levels of digital skills and trust towards digital technology providers are significantly more likely to accept smart charging strategies that favour CO2-minimal charging. Our results demonstrate that charging infrastructure planning needs to go hand-in-hand with user-centric factors, highlighting that users' adoption of smart charging strategies is dependent on mediators such as digital skills and high levels of trust.

Jonas Meli (ETH-IVT-TMP)

The influence of perceived train barriers on train usage

Jonas Meli (ETH-IVT-TMP), Katja Schimohr (ETH-IVT-TMP), Lea Stapper (ETH-D-GESS), Alessio Levis (ETH-D-GESS), Florian Lichtin (ETH-D-GESS), Stefan Wehrli (ETH-D-GESS), Thomas Bernauer (ETH-CIS), Eva Heinen (ETH-IVT-TMP)

Railway supply is often planned based on calculated accessibility, which can differ substantially from perceived accessibility, leading to a mismatch between supply and demand. Little is known about the perceived accessibility of train stations in Switzerland, how various obstacles to access are perceived, and how they influence different social groups' train use. This paper investigates the perception of various access obstacles and their impact on using trains as a main transport mode across different strata of Swiss society. We use data from the Swiss Mobility Panel (SMP). Participants were asked about their access mode preferences for work and/or leisure trips or, if they do not travel by train, their reasons for

not traveling by train. Additionally, participants answered questions about their perception of various potential obstacles, such as travel safety. We use structural equation modeling (SEM) to explore whether access obstacles influence train use, considering the perception of obstacles possibly differing with socio-demographic factors. The results help us understand the extent of the influence of various obstacles on different social groups. The knowledge of differences in the perception and effect of obstacles makes it possible to effectively reduce social disadvantages in access to the railway and increase its use.

Sessions 7: Friday, May 16th 2025

Sessions 7				
Chair	Arnór Elvarsson (ETH-IBI-IM)	**Session 7A**		
Room	Auditorium			
No.	**Start**	**End**	**Speaker**	**Title**
7.1	10:35	11:00	Xuhang Liu (EPFL-HOMES)	Population Markov Potential Game: An Alternative Framework for Markovian Traffic Assignment
7.2	11:00	11:25	Yasamin Borhani (EPFL-VITA)	PoseDriver: A Unified Approach to Multi-Class Skeleton Detection for Autonomous Driving
7.3	11:25	11:50	Arnór Elvarsson (ETH-IBI-IM)	Fast-lane for planning cycling infrastructure: On the effectiveness and efficiency of cycling infrastructure planning processes
Chair	Can Chen (EPFL-LUTS)	**Session 7B**		
Room	Sala Balint			
No.	**Start**	**End**	**Speaker**	**Title**
7.4	10:35	11:00	Zahra Ansarilari (ETH-IVT-TS)	The Impact of Bike Integration as an Access/Egress Mode in Transit Network Design: Insights from a Zürich Subnetwork
7.5	11:00	11:25	Xinyu Ma (EPFL-HOMES)	A tri-level model for the strategic game between the mobility-as-a-service (MaaS) platform and on-demand operators
7.6	11:25	11:50	Can Chen (EPFL-LUTS)	A perimeter control-route guidance framework of urban networks with priorities
Chair	Mohamed Abdelfattah (EPFL-VITA)	**Session 7C**		
Room	Sala Eranos			
No.	**Start**	**End**	**Speaker**	**Title**
7.7	10:35	11:00	Florian Fuchs (ETH-IVT-TS)	Hybrid Optimization for DISPLIB: Combining Logic-Based Benders with Conflict Discovery and MIP for Real-Time Railway Dispatching
7.8	11:00	11:25	Mohamed Abdelfattah (EPFL-VITA)	Self-supervised Learning of Unified Skeleton Representations with Decoupled Spatial-Temporal Momentum Contrast
7.9	11:25	11:50		

Session 7 - abstracts

Session 7A

Xuhang Liu

Population Markov Potential Game: An Alternative Framework for Markovian Traffic Assignment

Xuhang Liu (EPFL-HOMES), Kenan Zhang (EPFL-HOMES)

The Traffic Assignment Problem (TAP) predicts traffic flows on a given road network and demand profile, based on the equilibrium concept from game theory, where no driver has an incentive to change their route. TAP models are typically categorized as static or dynamic models, and deterministic or stochastic models. This study introduces a novel dynamic and stochastic TAP model, in which each vehicle's routing decision follows a Markov decision process (MDP). Traffic dynamics are Markovian, and stochastic routing behaviors are captured by a state-dependent policy. Existing Markovian TAP models focus on route choice as sequential link decisions within the MDP framework, with predefined policies (e.g., multinomial logit) and deterministic state transitions. In contrast, the proposed model removes these constraints, providing greater modeling flexibility. The model, termed the Population Markov Potential Game (PMPG), integrates concepts from population games, potential games, and Markov games. It considers the Markov potential game over a large population of agents and offers a robust framework with efficient solution methods. PMPG shows flexibility and practical usefulness for various transportation applications. Through an example of ride-hailing vehicles, we demonstrate that the PMPG framework enables us to achieve equilibrium solutions using the projected policy gradient method.

Yasamin Borhani

PoseDriver: A Unified Approach to Multi-Class Skeleton Detection for Autonomous Driving

Yasamin Borhani (EPFL-VITA), Taylor Mordan (MobiLysis), Javad Khoramdel (Tarbiat Modares University), Yihan Wang (EPFL-VITA), Reyhaneh Hosseininejad (EPFL-VITA), Alexandre Alahi (EPFL-VITA)

Skeletons provide a lightweight yet information-rich representation, making them well-suited for applications like autonomous driving, where computational efficiency and real-time performance are critical. This representation can effectively capture dynamic road users, such as cars, humans, and animals, as well as static road configurations like lanes. Despite their importance, lane detection has received significantly less attention compared to other perception tasks, and no existing framework efficiently detects all the relevant classes for autonomous driving.
In this work, we address these gaps by introducing a novel skeleton-based representation for lane detection, specifically designed to enhance compatibility with skeleton detection methods. We further develop a unified model capable of jointly detecting skeletons for cars, humans, animals, and lanes. To achieve this, we tackle several key challenges, including data imbalance, scaling issues, and task-specific variations. Our approach achieves state-of-the-art results in lane detection and demonstrates superior performance and computational efficiency for joint skeleton detection across all four classes.

Arnór Elvarsson

Fast-lane for planning cycling infrastructure: On the effectiveness and efficiency of cycling infrastructure planning processes

Arnór Elvarsson (ETH-IBI-IM), David Zani (ETH-IBI-IM), Bryan Adey (ETH-IBI-IM)

Policy-makers are tasked with shaping cycling infrastructure planning processes so that societal needs (e.g., safe travel without delay) and policy objectives (e.g., net-zero goals) can be met. However, planned infrastructure is often completed later than expected. This can be attributed to divergence in societal needs and the iterative nature of the infrastructure planning process. To complete its cycling network plan by 2043, Canton Zurich will require construction and modification of 602 road-kilometres. Some projects already lag behind, e.g., the Limmattal cycling highway. Meanwhile, the same project is estimated at ca. 50 million CHF, compared to the canton's annual cycling infrastructure budget of 20 million CHF. To ensure efficient and effective planning of cycling infrastructure to continually accommodate societal needs, this paper contributes an assessment and improvement suggestions for the cycling infrastructure planning process. This paper presents a three-step methodology based on case study review: First, the planning process is mapped for Canton Zurich. Second, the process is analysed based on the review of planning examples to identify challenges related to completing the network plan by 2043. Third, process improvements including a timely mandate for planners, an early-stage network overview of costs, and consistent consensus building facilitating efficient processes are proposed.

Session 7B

Zahra Ansarilari

The Impact of Bike Integration as an Access/Egress Mode in Transit Network Design: Insights from a Zürich Subnetwork

William Andersson (ETH-IVT-TS), Florian Fuchs (ETH-IVT-TS), Zahra Ansarilari (ETH-IVT-TS), Oleksandr Halipchak (ETH-IVT), Francesco Corman (ETH-IVT-TS)

While most transit network design studies overlook the role of biking as a mode of access and egress, those that do incorporate biking often limit their analyses to idealized grid networks with uniform demand distribution. This study addresses these gaps by integrating bikes into the transit network design of a realistic urban setting, using a detailed MATSim dataset for a Zürich subnetwork. We develop a mixed-integer model that minimizes passenger travel times—including access, egress, in-vehicle, and transfer times—as well as operating costs. By systematically adjusting bike-eligible demand percentages and the maximum biking distance limit, this study evaluates the impact of biking on passenger routes, travel times, and operational features of the network, including the configuration of lines, frequency, and the number of buses, trolleybuses, and trams. Preliminary findings indicate that bike integration significantly reduces both passenger travel times and operational costs, highlighting the critical need to integrate biking into transit network design problem.

Xinyu Ma

A tri-level model for the strategic game between the mobility-as-a-service (MaaS) platform and on-demand operators

Xinyu Ma (EPFL-HOMES), Kenan Zhang (EPFL-HOMES), Rui Yao (EPFL-HOMES)

This paper studies a multi-modal mobility system with a mobility-as-a-service (MaaS) platform, transportation network companies (TNCs), and mass transit (MT). The MaaS platform competes with TNCs and MT for travelers meanwhile cooperating with them to serve multi-modal trips. A tri-level model is formulated to capture the complex interactions among the stakeholders, where the MaaS platform designs service at the upper level, TNCs optimize their strategies at the middle level, and travelers make service choices following a nested logit (NL) model at the lower level. Numerical results show that a profit-maximizing MaaS platform can hardly survive in a market with excessive service capacity, whereas it becomes more appealing to long-distance travelers when travel time is prioritized over cost. On the other hand, when demand is high but insensitive to travel time, the MaaS platform may dominate the market by consolidating all service capacities of TNCs.

Can Chen

A perimeter control-route guidance framework of urban networks with priorities

Can Chen (EPFL-LUTS), Nikolas Geroliminis (EPFL-LUTS)

Recent efforts have been devoted to integrating perimeter control and regional route guidance (PCRG) to improve traffic efficiency in multi-region macroscopic fundamental diagram (MFD) based networks. However, few existing studies have explored an optimal strategy for an MFD-based system to maximize passenger trip completion with mixed traffic of vehicles carrying different numbers of passengers. The main objective of this paper is to develop an optimal PCRG framework to maximize the passenger trip completion of large-scale MFD-based urban traffic systems, where priority is provided for more efficient modes of transport. In the proposed control framework, vehicles carrying more than one passenger are prioritized (named prioritized vehicles (PVs)) over those carrying only one (named non-prioritized vehicles (NPVs)). Trip completion of PVs can yield more system benefits than NPVs. Hence, for some regions (e.g., the central business district) in the network, we assume a spatial distribution between trip priorities such that PVs exclusively utilize dedicated lanes to transport passengers, and NPVs share the remaining network. In the other regions, we assume a mixed traffic operation of PVs and NPVs. To the authors' best knowledge, this work is the first time to investigate the mixed-separated network representation and its optimal PCRG scheme to maximize passenger trip completion for the whole network.

Session 7C

Florian Fuchs

Hybrid Optimization for DISPLIB: Combining Logic-Based Benders with Conflict Discovery and MIP for Real-Time Railway Dispatching

Florian Fuchs (ETH-IVT-TS), Thomas Dubach (ETH-IVT-TS), Martin Iradi Bernardo (ETH-IVT), Jan Lordieck (ETH-IVT-TS), Francesco Corman (ETH-IVT-TS)

We present a hybrid optimization approach for real-time train dispatching in the DISPLIB challenge. Our method combines a delayed Logic-Based Benders Decomposition (LBBD) with a Mixed-Integer Programming (MIP) model, leveraging the strengths of both paradigms. The LBBD dynamically detects and separates conflicts, iteratively refining the problem structure to improve tractability. This enables us to solve 29 of the 43 instances to optimality. The remaining instances, characterized by extensive parallel routing and high symmetry, are effectively handled using the MIP formulation, which finds high-quality solutions within the computational limits of 8 cores, 10 minutes, and 32 GB RAM. Both approaches incorporate preprocessing and aggregation techniques, such as conflict filtering and independent route selection, to reduce problem size while maintaining solution quality. A parallel execution framework further accelerates computation by distributing workload across solvers. Our results demonstrate the effectiveness of conflict-driven decomposition for complex railway dispatching problems, balancing exact optimization with heuristic refinement.

Mohamed Abdelfattah

Self-supervised Learning of Unified Skeleton Representations with Decoupled Spatial-Temporal Momentum Contrast

Mohamed Abdelfattah (EPFL-VITA), Alexandre Alahi (EPFL-VITA)

How can a model learn skeleton representations that work seamlessly across multiple tasks? Traditional self-supervised methods, often reliant on masked self-reconstruction, fall short by entangling spatial and temporal features, limiting their adaptability to complex downstream tasks. In this paper, we introduce MotionMoCo, a novel self-supervised framework designed to decouple spatial and temporal information for robust, transferable skeleton representations. MotionMoCo consists of two branches—a query branch and a momentum-updated key branch—each of which separately encodes the spatial, temporal, and combined features from the input sequence. Unlike previous works, we contrast these features separately across the two branches, thus maintaining their unique information content. Further, we propose a Motion-Aware Frame Masking strategy that selectively removes the fast-evolving frames in the query branch to encourage robust feature extraction. MotionMoCo demonstrates strong generalization capability across skeleton-based action recognition, 2D-to-3D pose lifting, and human mesh recovery, proving that spatiotemporal disentanglement enhances the quality and adaptability of skeleton representations.

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